Liquefied Petroleum Gas (LPG) Fuel System For 2002 GM 5.7L G Van

Website 103133

Liquefied Petroleum Gas (LPG)
Fuel System
For
2002 GM 5.7L G Van

This manual provides information on the diagnosis, the service procedures, the adjustments and the specifications for the Liquefied Petroleum Gas (LPG) Fuel System as used on the 2002 GM 5.7L G Van. **This manual is a supplement to be used with 2002 GM G Van service manual.**

IMPORTANT!

Perform the Alternative Fuels Powertrain On-board Diagnostic (AF OBD) System Check on page 20 *before* contacting QUANTUM® Technical Assistance at 1-800-816-8691.

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VEHICLE APPLICATION

The QUANTUM® propane system is designed for the 2002 LPG G Van with the 5.7L V 8 (RPO L31).

PROPANE FUEL SYSTEM CAUTIONS

CAUTION: Do not smoke, carry lighted tobacco, or use a lighted flame of any type when working on or near any fuel related component. Highly flammable air-fuel mixtures may be present and can be ignited causing personal injury.

CAUTION: Do not allow propane to contact the skin. Propane is stored in the fuel tank as a liquid. When propane contacts the atmosphere, it immediately expands into a gas, resulting in refrigeration that can cause severe burns.

CAUTION: Do not allow propane to accumulate in areas below ground level such as in a service pit or under an alignment rack. Propane is heavier than air and can displace oxygen, creating a dangerous condition.

DESCRIPTION AND OPERATION

PROPANE FUEL SYSTEM

The primary components of the propane fuel system are the low pressure regulator, fuel mixer, electric lock-off solenoids and engine control module (ECM). The system operates at pressures up to 312 psi.

Fuel is stored in the LPG fuel tank. Propane is delivered from the tank through a lock-off solenoid on the tank, through an LPG fuel filter mounted on the inside of the driver side frame rail and then to the underhood low pressure lock-off solenoid (LPL). The OEM fuel pump control circuit powers the fuel tank lock-off. This lock is hardwired to engine ground. The AF ignition relay powers the underhood LPL. The AF ECM controls the underhood lock-off by opening or closing the ground circuit. The lock-offs, which are normally closed, open only when the engine is cranking or running. Fuel passes through the underhood low pressure lock-off solenoid to the fuel inlet on the LPR.

Propane enters the LPR through the primary jet and into the primary chamber where the fuel is vaporized as it passes through the heat exchanger located in the center of the regulator and the pressure is reduced to approximately 2.5 psi. As the fuel flows into the LPR secondary chamber, the pressure is reduced to approximately negative 1.8 inches of water column.

When the engine is cranking or running, a pressure drop is created by airflow into the engine as it passes through venturi in the fuel mixer. This pressure drop is commonly referred to as air valve vacuum. As air valve vacuum increases with airflow, the amount of fuel drawn from the LPR secondary chamber into the mixer will also increase. In the fuel mixer, the propane vapor is combined with air to form a combustible air/fuel mixture. The mixture is then drawn into the engine.

The A/F mixture is controlled by the Alternative Fuel Engine Control Module (AF ECM), the fuel control solenoid (FCS) and idle control solenoid (ICS). The AF ECM receives input from various engine sensors to determine the amount of fuel necessary to maintain a precise air/fuel mixture across the entire engine operational range. The AF ECM then sends commands to the fuel control solenoid (FCS) and idle control solenoid (ICS) to meter the appropriate quantity of fuel. The FCS meters the fuel flow by modulating the pressure on top of the regulator diaphragm to control fuel output pressure. The ICS meters supplemental fuel flow from the LPR secondary chamber into the mixer. The system will also automatically sense and compensate for changes in altitude.

LPG FUEL TANK

The LPG fuel tank is located under the rear of the vehicle, behind the rear axle. LPG fuel fill capacity is 29 gallons. The tank complies with ASME and NFPA standards.

FUEL TANK LOCK-OFF

The electric fuel tank lock-off solenoid provides electronic fuel shut-off for pressures up to 312 psi. It is a normally closed solenoid operated lock-off with a manual shut-off override valve. If the lock-off fails, it is designed to fail in the closed position. The solenoid has a high temperature coil and is both UL and CGA approved.

UNDERHOOD LOW PRESSURE LOCK-OFF (LPL)

The underhood electric low pressure lock-off solenoid provides electronic fuel shut-off for pressures up to 312 psi. It is a normally closed solenoid operated lock-off with a 1/4" diameter fuel orifice. If the lock-off fails, it is designed to fail in the closed position. The solenoid has a high temperature coil and is both UL and CGA approved.

LOW PRESSURE REGULATOR (LPR)

The QUANTUM® Model E low pressure regulator (LPR) is a combined pressure regulator and vaporizer. The regulator is a negative pressure two-stage configuration that is closed when the engine is not running. When the engine is cranking or running, the air valve vacuum created is communicated to the regulator. This opens the regulator, permitting fuel to flow to the fuel mixer.
The regulator receives liquid fuel at tank pressure. The pressure is reduced in two stages to slightly less than atmospheric. In the first stage, the pressure is reduced to approximately 2.5 psi. Also during this stage, the liquid fuel is vaporized by heating the base of the LPR with engine coolant. A sponge located in the primary chamber absorbs any liquid fuel and prevents it from entering the secondary chamber. In the second stage, the vaporized fuel is drawn into the secondary chamber where the pressure is reduced to approximately negative 1.8 inches of water column.

FUEL MIXER

The QUANTUM® Model 425 fuel mixer is an air-fuel metering device. It requires no linkage or idle vacuum line to the intake manifold. The mixer is an air valve design, utilizing a relatively constant pressure drop to draw fuel into the mixer from cranking to full load.

The vacuum applied to the air valve, working against a spring located on top of the valve, correctly positions the air valve to meter the proper amount of fuel for any given engine speed and load. The pressure drop that is controlled by the air valve spring provides the force to draw fuel into the air stream. The upward movement of the diaphragm controls the fuel flow in the venturi air valve.

A pressure drop under the air valve of approximately 0.2 psi (6" water column) of pressure is required to lift the air valve off its seat. Approximately 0.5 psi (13.8" water column) lifts the valve to the top of its travel in full open position. Lowered pressure communicated to the top of the diaphragm varies with engine speed and position of throttle valve opening. The air valve assembly measures the air flow into the engine by moving precisely in response to the demands of the engine and throttle valve position.

The controlled pressure drop of 0.2 to 0.5 psi (6" to 13.8" water column) set up by the metering spring provides the signal or force necessary to draw fuel into the air stream within the carburetor. The gas metering valve is attached to the air valve assembly and is shaped to admit the correct amount of fuel from the gas jet to mix with incoming air at any opening of the air valve.

ALTERNATIVE FUEL ENGINE CONTROL MODULE (AF ECM)

The alternative fuel engine control module (AF ECM) controls the propane fuel system. The AF ECM monitors various engine and vehicle functions to provide the correct amount of fuel under all operating conditions. This provides excellent driveability and fuel economy while maintaining reduced exhaust emission levels.

CONTROL SOLENOIDS

FUEL CONTROL SOLENOID (FCS)

An electrically actuated control solenoid used to trim fuel mixtures by controlling the pressure on top of the LPR secondary diaphragm. During closed loop operation, the ECM commands a duty cycle to the fuel control solenoid (FCS). The FCS converts this to a mechanical signal and modulates air valve vacuum on top of the LPR secondary diaphragm.

By controlling the pressure on top of the LPR secondary diaphragm, the ECM can control the LPR output pressure and fuel flow to the mixer. A high FCS duty cycle means the ECM is issuing a lean command to control a rich condition. A low FCS duty cycle means the ECM is issuing a rich command to control a lean condition.

IDLE CONTROL SOLENOID (ICS)

An electrically actuated control solenoid used to meter supplemental fuel to the engine, which increases fuel control authority during idle and low speed operation. During closed loop operation, the ECM commands a duty cycle to the idle control solenoid (ICS) that is the opposite of the FCS.
A high ICS duty cycle means the ECM is issuing a rich command to control a lean condition. A low ICS duty cycle means the ECM is issuing a lean command to control a rich condition.

SYSTEM OPERATION FEATURES

COLD WEATHER STARTS
The AF ECM will illuminate the "WAIT TO DRIVE" lamp located on the dash until the engine coolant temperature is between 0°C to 30°C depending on ambient temperature. This permits proper LPG vaporization and prevents the low pressure regulator (LPR) from freezing. The AF ECM will shut off the engine by closing the LPL if the operator attempts to drive the vehicle before the coolant has reached the minimum temperature.

FUEL QUALITY
The LPG fuel system is designed for use with HD5 grade propane. Lower grades of propane, especially those with high butane content, may affect vehicle performance and emissions. Also, lower grades of propane may contain higher levels of contaminants that can plug the LPG fuel filter. Repairs that are the result of system contamination due to poor fuel quality may not be covered under warranty.

MAINTENANCE SCHEDULE

The following maintenance items are specific to the LPG fuel system. These items are required *in addition to* the maintenance items listed in the GM owner's manual.

The services shown in this schedule should be performed after 120,000 miles (200 000 km) at the same intervals.

30,000 MILES (50 000 KM)
- Inspect intake system for vacuum leaks.
- Replace LPG fuel filter (or every 12 months, whichever occurs first). *(3)*
- Check all vacuum lines and fittings.
- Check all fuel lines and fittings.
- Perform ignition system inspection. *(28)*

60,000 MILES (100 000 KM)
- Check intake system for vacuum leaks.
- Replace LPG fuel filter (or every 12 months, whichever occurs first). *(3)*
- Check all vacuum lines and fittings.
- Check all fuel lines and fittings.
- Replace spark plugs and perform ignition system inspection. *(28)*
- Perform mixer air valve service. *(60)*

90,000 MILES (150 000 KM)
- Check intake system for vacuum leaks.
- Replace LPG fuel filter (or every 12 months, whichever occurs first). *(3)*
- Check all vacuum lines and fittings.
- Check all fuel lines and fittings.
- Perform ignition system inspection. *(28)*

120,000 MILES (200 000 KM)
- Check intake system for vacuum leaks.
- Check converter / check regulator primary and secondary pressures. *(61)*
- Replace LPG fuel filter (or every 12 months, whichever occurs first). *(3)*
- Check all vacuum lines and fittings.
- Check all fuel lines and fittings.
- Replace spark plugs and perform ignition system inspection. *(28)*
- Perform mixer air valve service. *(60)*

FOOTNOTES
- (3) = An Emission Control Service.
- (28) = Remove and inspect the spark plugs for wear or damage. Inspect the spark plug wires for damage. Check the spark plug wire connections at the plug and at the distributor. Inspect wire harness connections at the distributor. Repair or replace parts as necessary.

- (60) = Remove the mixer cover and spring from the mixer. Remove the air valve assembly from the mixer body. Inspect for dirt, oil contamination or damage. Clean or repair as necessary.
- (61) = If primary and secondary pressures are within specification, no further action is necessary. If pressures are out of specification, remove converter cover, spring and diaphragm. Inspect for dirt, oil contamination or damage. Clean or repair as necessary.

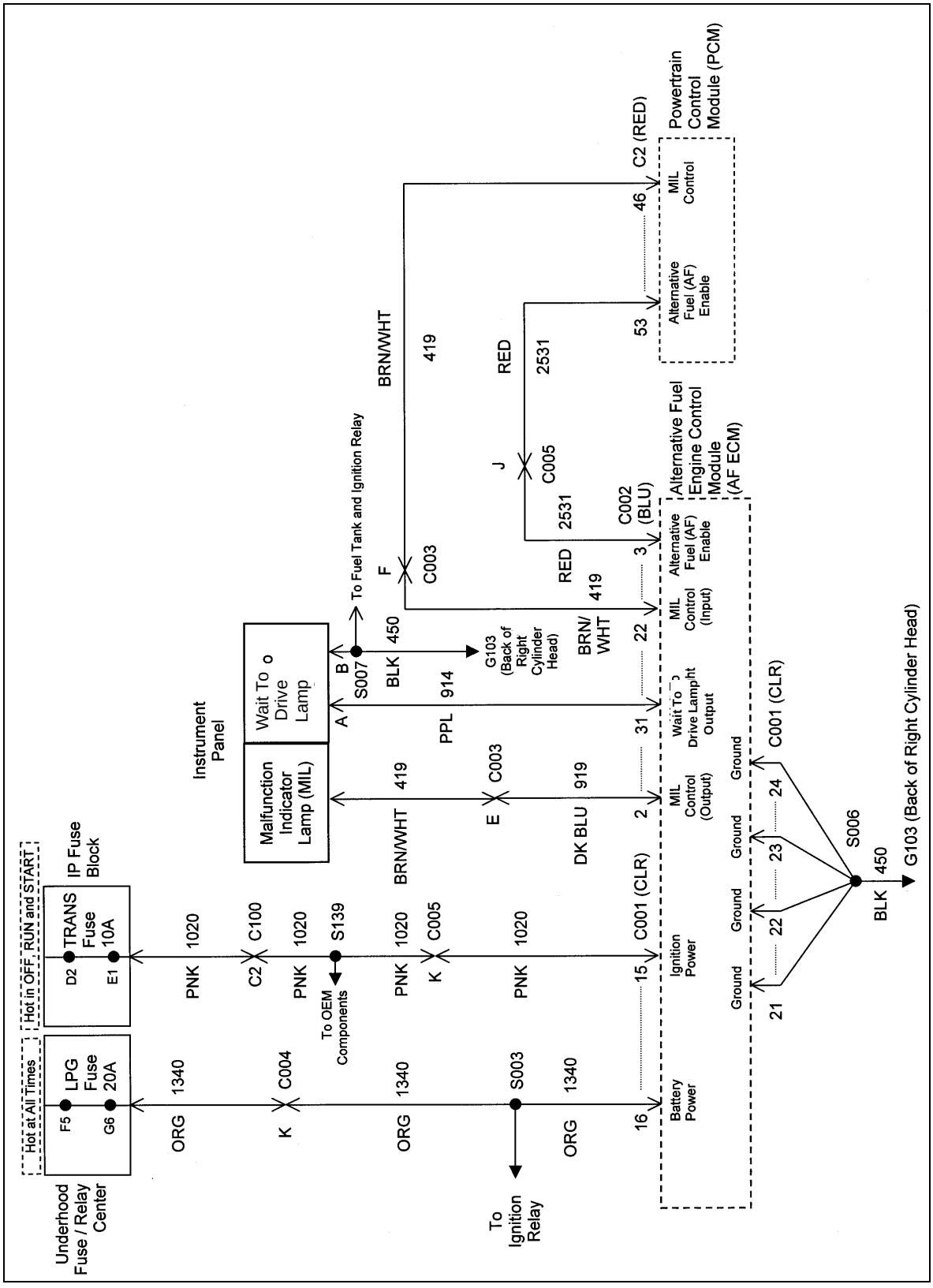
NORMAL MAINTENANCE REPLACEMENT PARTS

LPG Fuel Filter	F4-20804-001
Spark Plugs	AC Delco 41-932
Spark Plug Gap	0.060”

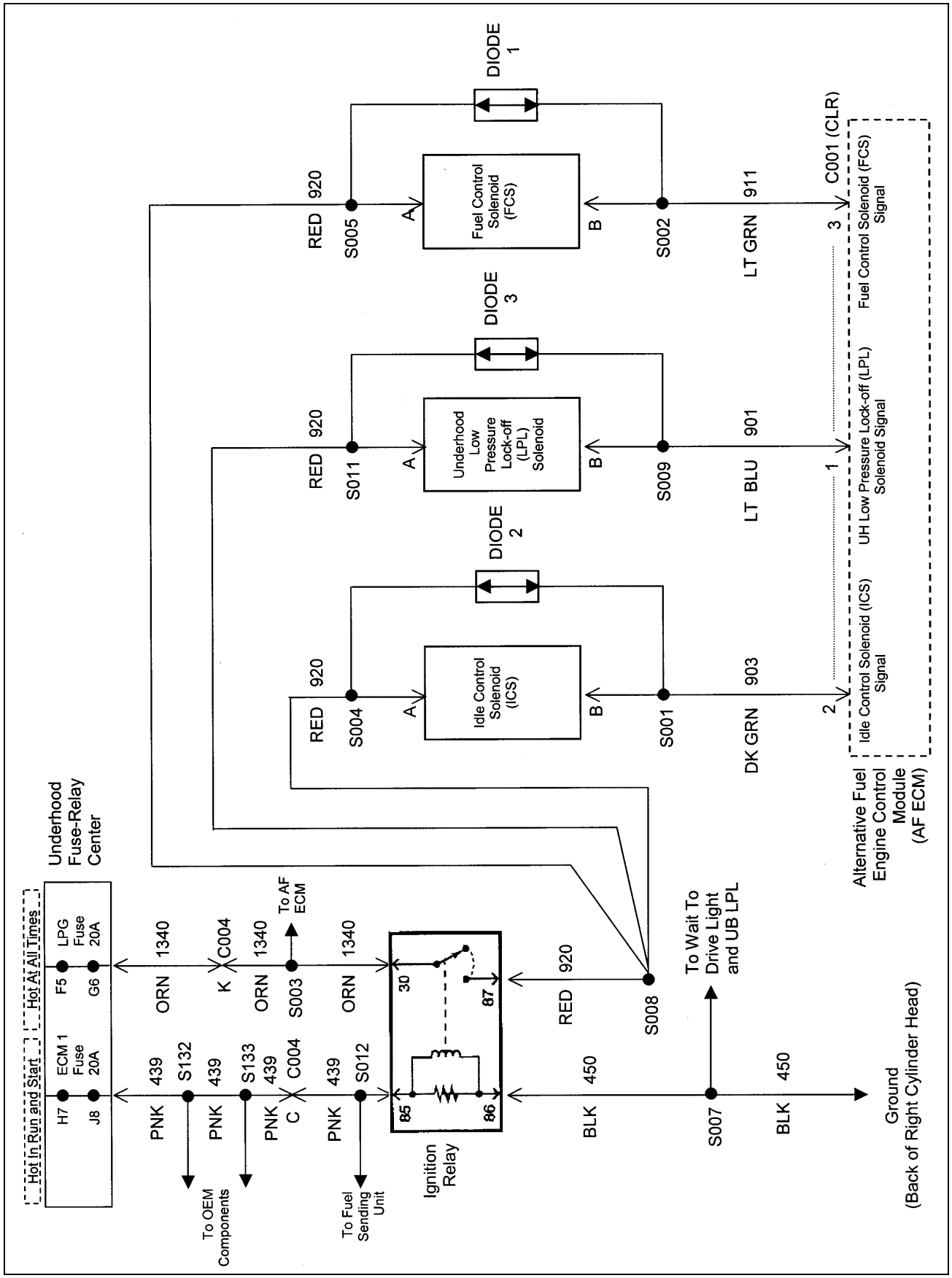
DIAGNOSTIC INFORMATION AND PROCEDURES

Engine Controls Schematics

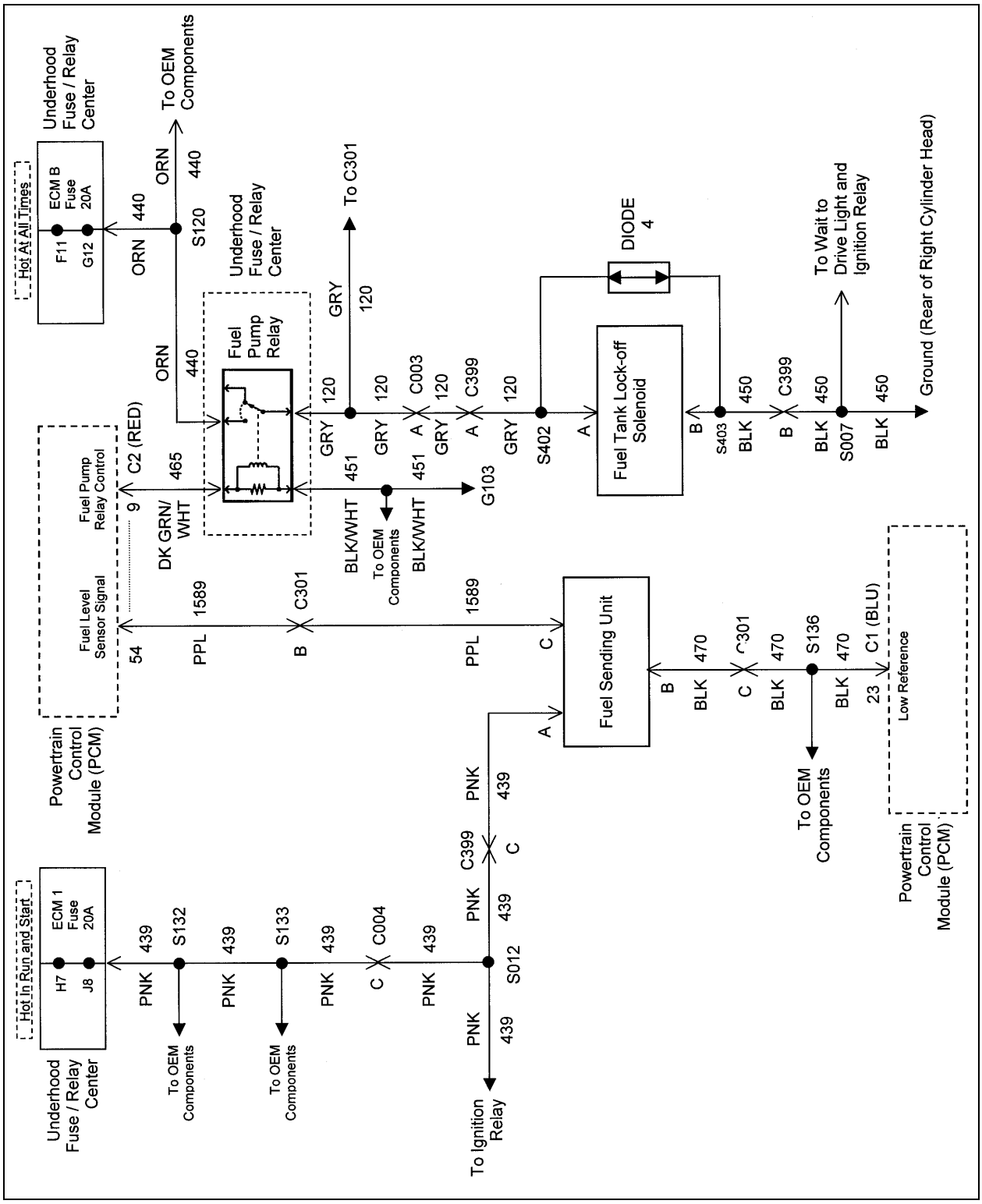
Power, Ground, MIL, Wait to Drive Lamp and AF Enable



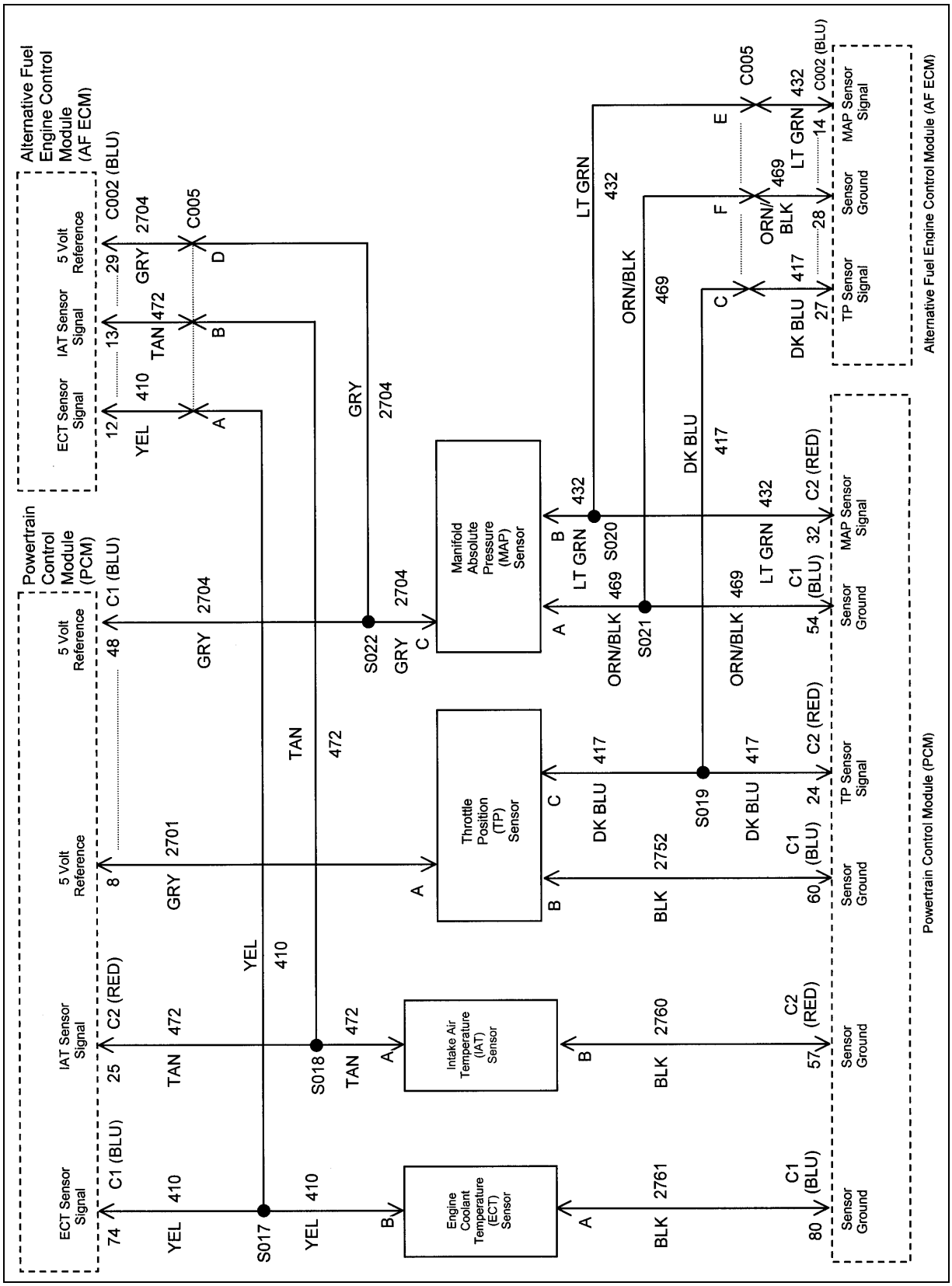
Fuel and Idle Control Solenoids and Underhood Low Pressure Lock-off (LPL) Solenoid



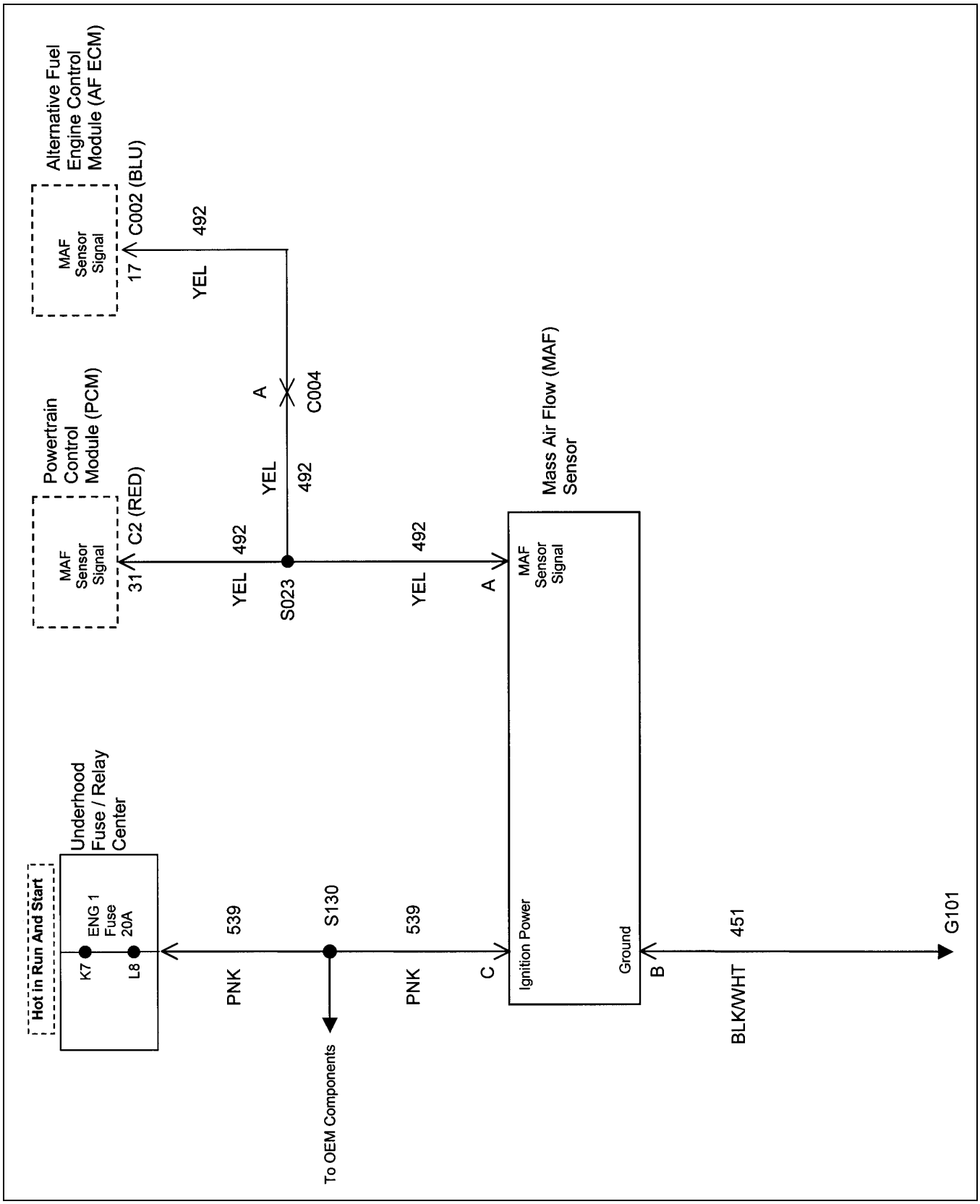
Fuel Tank Lock-off Solenoid and Fuel Sending Unit



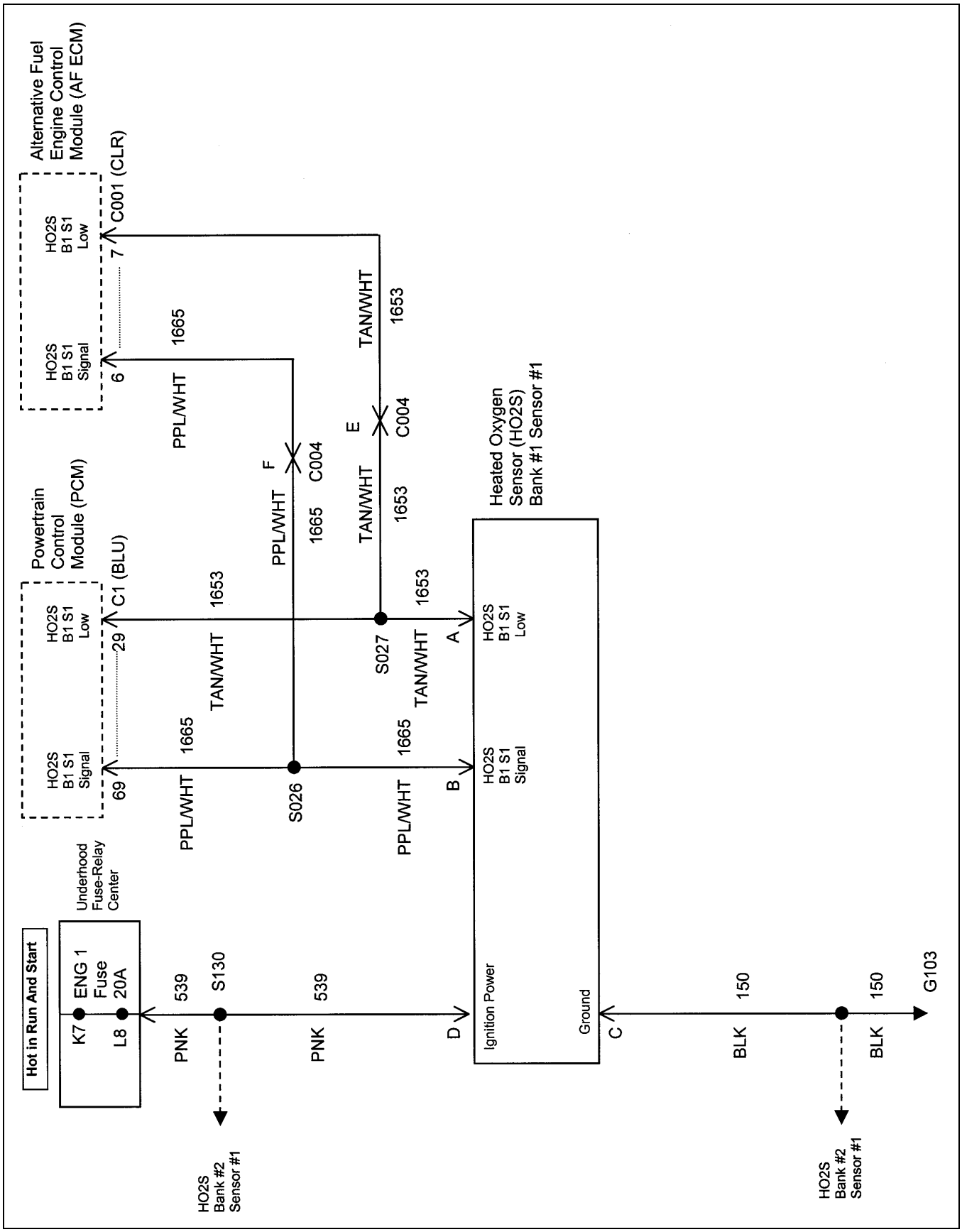
Engine Coolant Temperature (ECT), Intake Air Temperature (IAT), Throttle Position (TP), and Manifold Absolute Pressure Sensors



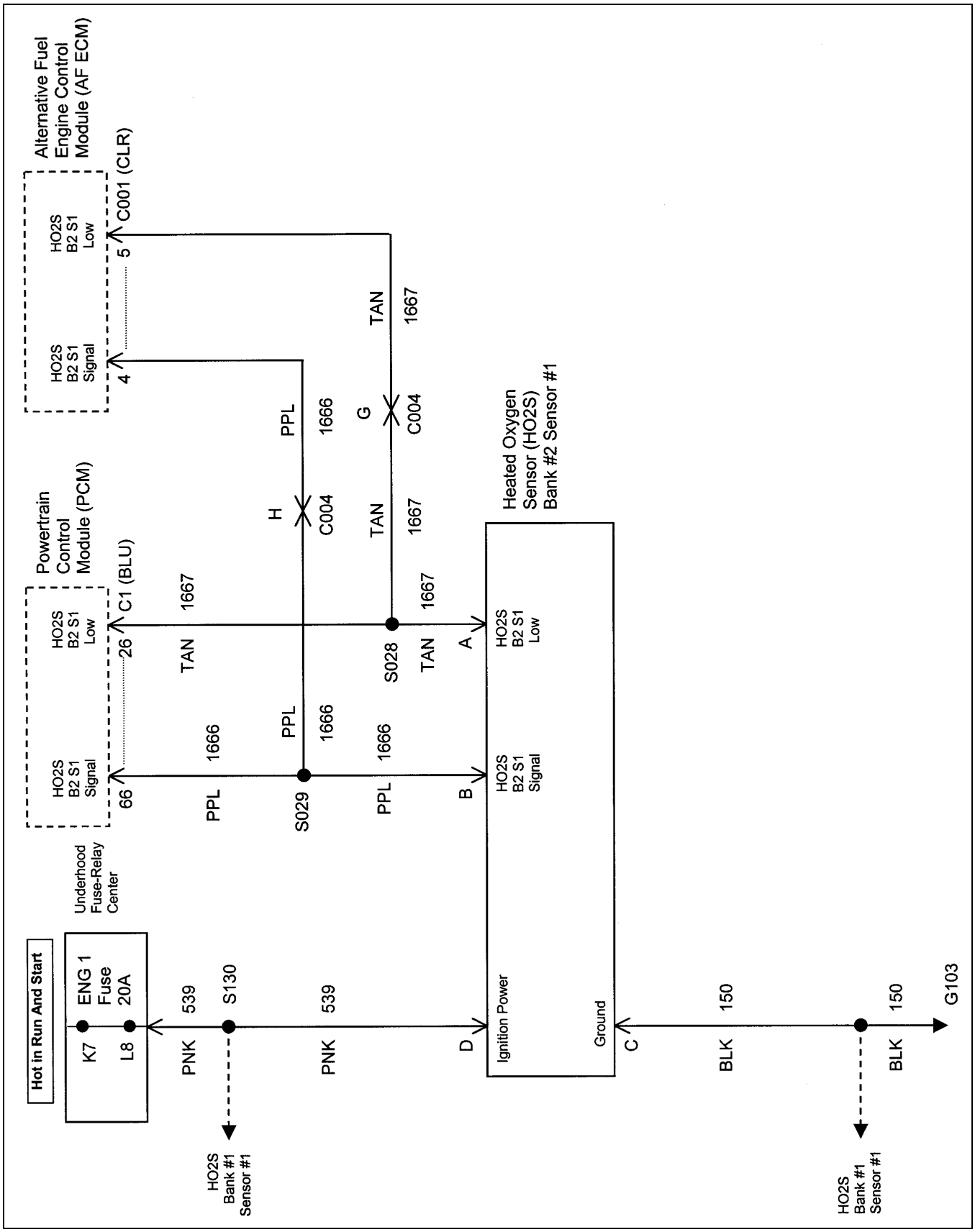
Mass Airflow (MAF) Sensor



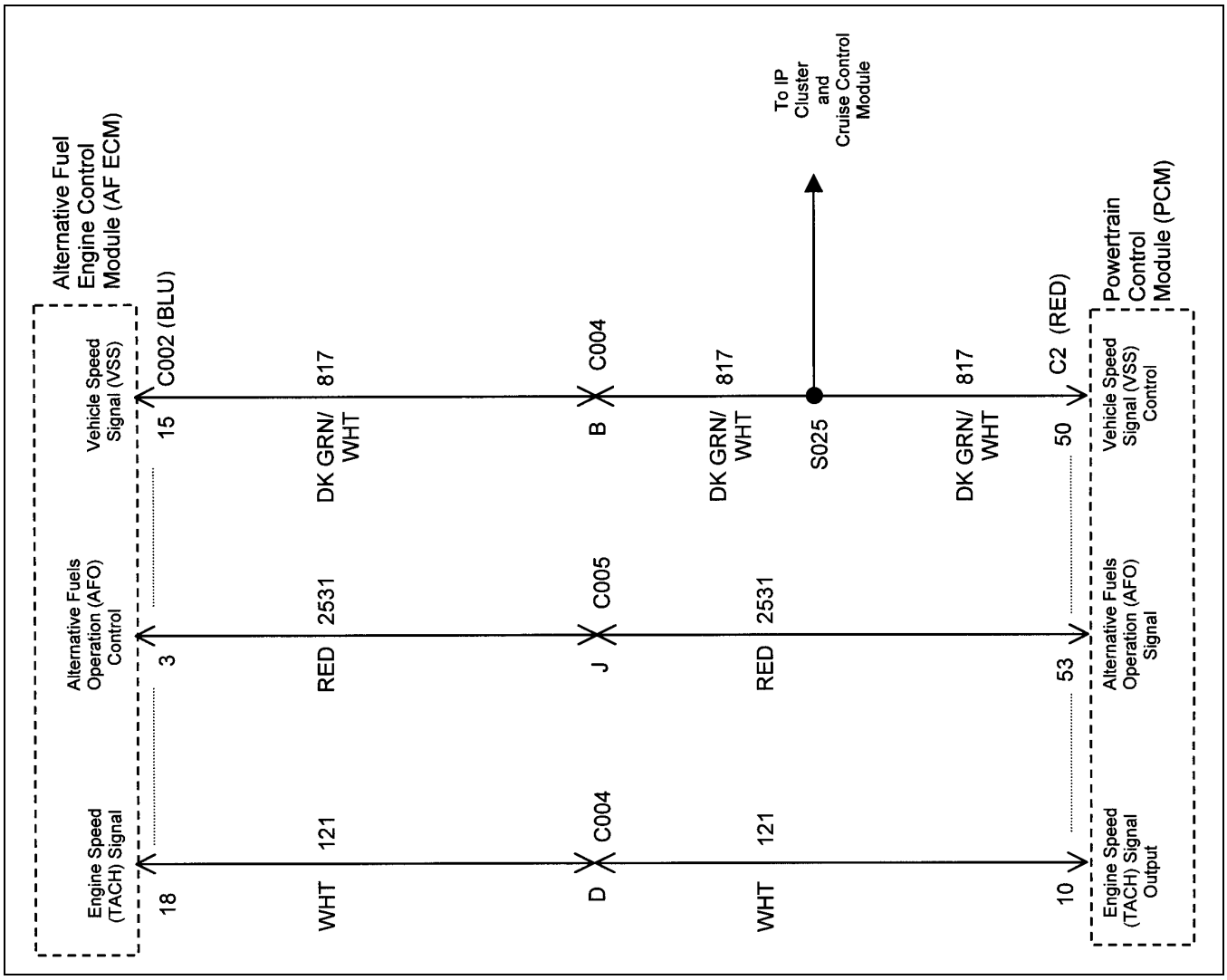
Heated Oxygen Sensor (HO2S) Bank 1 Sensor 1



Heater Oxygen Sensor (HO2S) Bank 2 Sensor 1

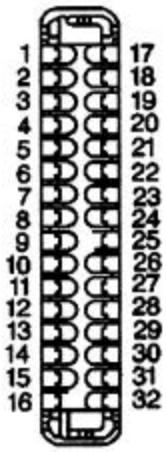


Engine Speed (TACH), AF Operation and Vehicle Speed Signal (VSS)



Connector End Views

AF ECM Clear C001 32 Pin Connector End View

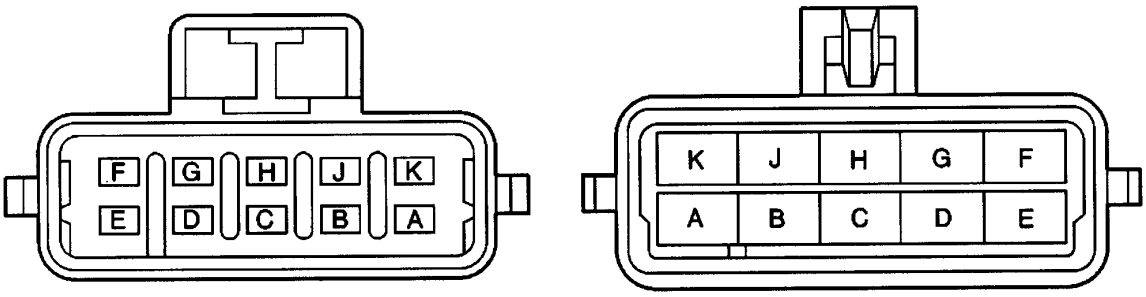


Connector Part Information		· 12129025 • C001 32 Pin Connector (Clear)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	LT BLU	901	LPL Signal (Ground)
2	DK GRN	903	Idle Control Solenoid Signal (Duty Cycle)
3	LT GRN	911	Fuel Control Solenoid Signal (Duty Cycle)
4	PPL	1666	HO2S B2 S1 Signal
5	TAN	1667	HO2S B2 S1 Low
6	PPL/WHT	1665	HO2S B1 S1 Signal
7	TAN/WHT	1653	HO2S B1 S1 Low
8-14	-	-	Not Used
15	PNK	1020	Ignition
16	ORG	1340	Battery
17-19	-	-	Not Used
20	BLK	925	Calibrator Ground (Assembly Use Only)
21	BLK	450	Ground
22	BLK	450	Ground
23	BLK	450	Ground
24	BLK	450	Ground
25-31	-	-	Not Used
32	RED	926	Calibrator Power (Assembly Use Only)

AF ECM Blue C002 32 Pin Connector End View

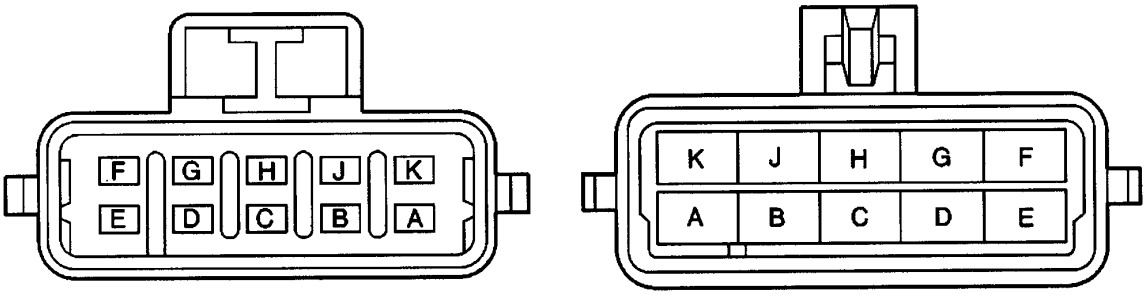
Connector Part Information		· 12129025 • C002 32 Pin Connector (Blue)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	PPL	1807	Class II Serial Data
2	DK BLU	919	OEM MIL
3	RED	2531	Alternative Fuel Enable
4	-	-	Not Used
5	WHT	924	TXD (Assembly Use Only)
6-9	-	-	Not Used
10	DK GRN	923	RXD (Assembly Use Only)
11	-	-	Not Used
12	YEL	410	ECT Sensor Signal
13	TAN	472	IAT Sensor Signal
14	LT GRN	432	MAP Sensor Signal
15	DK GRN / WHT	817	VSS Signal
16	-	-	Not Used
17	YEL	492	MAF Sensor Signal
18	WHT	121	Engine Speed (RPM) Signal
19-21	-	-	Not Used
22	BRN / WHT	419	MIL Input
23-26	-	-	Not Used
27	DK BLU	417	TP Sensor Signal
28	ORG / BLK	469	Voltage Reference Low
29	GRY	2704	Voltage Reference High
30	-	-	Not Used
31	PPL	914	Wait to Drive Light
32	-	-	Not Used

Inline Harness Connector C004 (GRY)



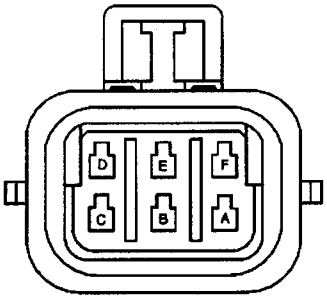
Connector Part Information		• 12065426 (AF Harness Side) • 10 Way Metri-Pack Sealed 150 Series (GRY)		Connector Part Information		• 12052189 (OEM Harness Side) • 10 Way Metri-Pack Sealed 150 Series (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	YEL	492	MAF Sensor Signal	A	YEL	492	MAF Sensor Signal
B	DK GRN / WHT	817	VSS Signal	B	DK GRN / WHT	817	VSS Signal
C	PNK	439	Ignition Power	C	PNK	439	Ignition 1
D	WHT	121	Engine Speed (RPM) Signal	D	WHT	121	Engine Speed (RPM) Signal
E	TAN	1653	HO2S Low	E	TAN	1653	HO2S Low
F	PPL / WHT	1665	HO2S B1 Signal	F	PPL / WHT	1665	HO2S B1 Signal
G	TAN	1667	HO2S Low	G	TAN	1667	HO2S Low
H	PPL	1666	HO2S B2 Signal	H	PPL	1666	HO2S B2 Signal
J	-	-	Not Used	J	-	-	Not Used
K	ORN	1340	Battery Power	K	ORN	1340	Battery Power

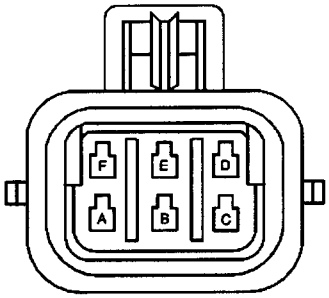
Inline Harness Connector C005 (BLK)



Connector Part Information		• 12065425 (AF Harness Side) • 10 Way Metri-Pack Sealed 150 Series (BLK)		Connector Part Information		• 12045808 (OEM Harness Side) • 10 Way Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	YEL	410	ECT Signal	A	YEL	410	ECT Signal
B	TAN	472	IAT Sensor	B	TAN	472	IAT Sensor
C	DK BLU	417	TP Sensor Signal	C	DK BLU	417	TP Sensor Signal
D	GRY	2704	Voltage Reference High	D	GRY	2704	Voltage Reference High
E	LT GRN	432	MAP Signal	E	LT GRN	432	MAP Signal
F	ORG / BLK	469	Voltage Reference Low	F	ORG / BLK	469	Voltage Reference Low
G	-	-	Not Used	G	-	-	Not Used
H	PPL	1807	Class II Serial Data	H	PPL	1807	Class II Serial Data
J	RED	2531	Alternative Fuel (AF) Enable	J	RED	2531	Alternative Fuel (AF) Enable
K	ORG	1020	Ignition Power	K	PNK	1020	Ignition Power

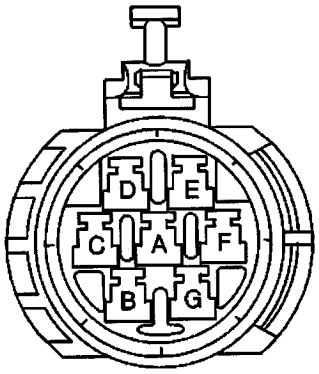
In-line Harness Connector C003

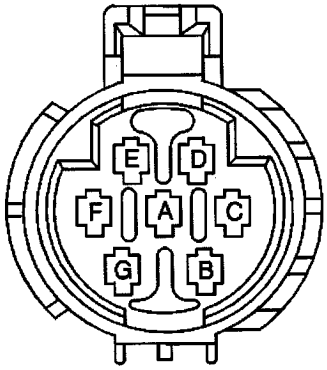




Connector Part Information		• 12052848 (AF Harness Side) • 6-way Metri-Pack Sealed 150 Series (BLK)		Connector Part Information		• 12124107 (OEM Harness Side) • 6-way Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	GRY	120	Fuel Pump Power	A	GRY	120	Fuel Pump Power
B	-	-	Not Used	B	-	-	Not Used
C	BLK	918	Fuel Gauge Signal (From PCM)	C	BLK	918	Fuel Gauge Signal (From PCM)
D	BLK	918	Fuel Gauge Signal (To Fuel Gauge)	D	BLK	918	Fuel Gauge Signal (To Fuel Gauge)
E	DK BLU	919	MIL Output (To MIL Lamp)	E	DK BLU	919	MIL Output (To MIL Lamp)
F	BRN / WHT	419	MIL Input (From PCM)	F	BRN / WHT	419	MIL Input (From PCM)

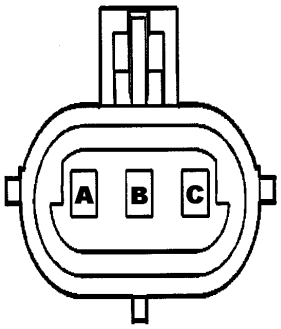
In-line Harness Connector C301

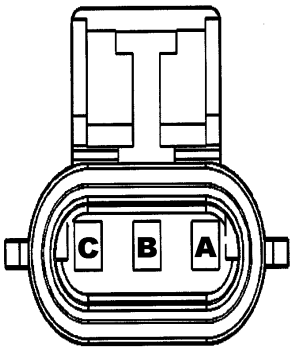




Connector Part Information		• 12110751 (OEM Harness) • 7-way F Metri-Pack 280 Series (BLK)		Connector Part Information		• 12110753 (AF Harness) • 7-way M Metri-Pack 280 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BLK	150	Ground	A	BLK	470	Ground
B	PPL	1589	Fuel Level Sensor – Primary	B	PPL	1589	Fuel Level Sensor – Primary
C	BLK	470	5 Volt Reference	C	-	-	Not Used
D	GRY	474	5 Volt Reference (w/ NB6)	D	-	-	Not Used
E	DK GRN	890	Fuel Tank Pressure Sensor Signal (w/ NB6)	E	-	-	Not Used
F	BLK	470	Low Reference (w/ NB6)	F	-	-	Not Used
G	GRY	120	Fuel Pump Supply Voltage	G	-	-	Not Used

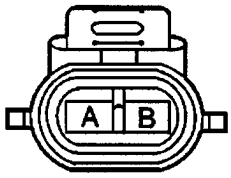
In-line Harness Connector C399





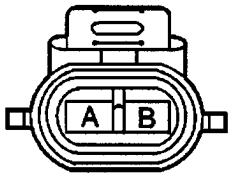
Connector Part Information		• **12129615 (AF Engine Side)** • **3-way M Metri-Pack 150 Series (BLK)**		**Connector Part Information**		• **12110293 (AF Tank Side)** • **3-way F Metri-Pack 150 Series (BLK)**	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	GRY	120	Fuel Pump Relay Power	A	GRY	120	Fuel Pump Relay Power
B	BLK	450	Ground	B	BLK	450	Ground
C	PNK	439	Ignition Power	C	PNK	439	Ignition Power

Idle Control Solenoid (ICS) Connector C006



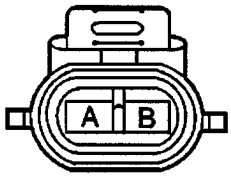
Connector Part Information		• 12052643 • 2-way Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	920	12V Power (From Ignition Relay)
B	DK GRN	903	Idle Control Solenoid Signal (Duty Cycle)

Fuel Control Solenoid (FCS) Connector C007



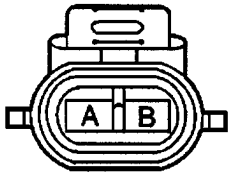
Connector Part Information		• 12124037 • 2-way Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	920	12V Power (From Ignition Relay)
B	LT GRN	911	Fuel Control Solenoid Signal (Duty Cycle)

Underhood LPL Connector C008



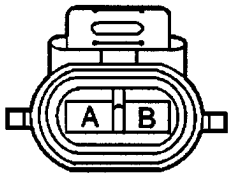
Connector Part Information		• 12052641 • 2-way Female Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	920	12V Power (From Ignition Relay)
B	LT BLU	901	LPL Signal

Wait To Drive Lamp Connector C199



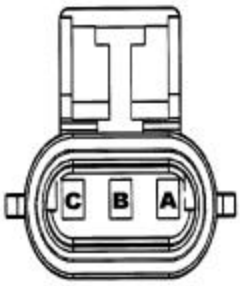
Connector Part Information		• 12047683 • 2-way Metri-Pack Sealed 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	914	Wait To Drive Lamp Signal
B	LT BLU	450	Ground

Tank Lock-off Connector C450



Connector Part Information	• 12052641 • 2-way Female Metri-Pack Sealed 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRY	120	Fuel Pump Relay Power
B	BLK	450	Ground

Fuel Sender Connector C451



Connector Part Information	• 12129615 • 3-way Metri-Pack Sealed 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRY	120	Fuel Pump Relay Power
B	BLK	470	Low Reference
C	PPL	1589	Fuel Level Sensor Signal

AF Engine Scan Tool Data List

Engine Idling / Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Accessories Off		
Scan Tool Parameter	**Parameter Range / Units**	**Typical Data Values**
Engine Speed	0-10,000 RPM	500-700 RPM
Engine Run Time	Hrs, Mins, Sec	Varies
Loop Status	Open / Closed	Closed
HO2S Bank 1 Sensor 1	0-1000 mV	Varies between 100 – 900 mV
HO2S Bank 2 Sensor 1	0-1000 mV	Varies between 100 – 900 mV
Short Term Fuel Trim Bank 1	Percentage	Near 0% ± 20%
Long Term Fuel Trim Bank 1	Percentage	Near 0% ± 20%
IAT Sensor	-39° to +140°C (-38° to +284°F)	35°C (91°F) (Depending on ambient temperature)
ECT Sensor	-39° to +140°C (-38° to +284°F)	88° to 105°C (190° to 221°F)
Engine Load	0-100%	2-5%
MAP Sensor	kPa (volts)	20-48 kPa (1.0-2.0 V)
MAF Sensor	Grams per Second (g/s)	6-10 g/s
MAF Sensor	0-31,999 Hz	2500-3500 Hz
TP Sensor	0-5V	0-5V
TP Sensor	0-100%	0-100%
Vehicle Speed Sensor	km/hr / mph	0
Battery Voltage	0-25 Volts	11.5-14.5 volts
Ignition 0 Signal	0-25 Volts	11.5-15.5 volts
Reference Voltage Low	Volts	0.0-0.1 V
Reference Voltage High	Volts	4.9-5.1 V
(Alt. Fuel) MIL Command	ON / OFF	OFF
AFO Signal Command	N/A	AF ECM
(PCM) MIL Command	ON / OFF	OFF
UH Low Pressure Lock-off	OFF / FUEL FLOW	FUEL FLOW
Alternative Fuel Run Time Log	Hrs, Mins, Sec	Varies
Fuel Control Duty Cycle	0-100%	20%-80%
Idle Duty Cycle	0-100%	20%-80%

AF ECM Output Driver Data

Driver Circuit	Parameter Range / Units	Typical Data Values
AFO Signal	-	AF ECM
AFO Signal Command	-	AF ECM
AFO Enable Circuit	OK / Short / Open	OK
MIL Output Circuit	OK / Short / Open	OK
LPL Solenoid Input Circuit	OK / Short / Open	OK
Idle Control Circuit	OK / Short / Open	OK
Fuel Control Circuit	OK / Short / Open	OK

AF Diagnostic Trouble Code (DTC) List

Diagnostic Trouble Code (DTC) List	Type	Illuminate MIL
DTC P0102 (36) Mass Air Flow (MAF) Sensor Circuit Low Frequency	A	Yes
DTC P0103 (37) Mass Air Flow Sensor Circuit High Frequency	A	Yes
DTC P0106 (32) Manifold Absolute Pressure (MAP) System Performance	B	Yes
DTC P0107 (34) Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage	B	Yes
DTC P0108 (33) Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage	B	Yes
DTC P0112 (23) Intake Air Temperature (IAT) Sensor Circuit Low Voltage	B	Yes
DTC P0113 (25) Intake Air Temperature (IAT) Sensor Circuit High Voltage	B	Yes
DTC P0117 (15) Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	B	Yes
DTC P0118 (14) Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	B	Yes
DTC P0121 (26) Throttle Position (TP) Sensor Performance	B	Yes
DTC P0122 (22) Throttle Position (TP) Sensor Circuit Low Voltage	B	Yes
DTC P0123 (21) Throttle Position (TP) Sensor Circuit High Voltage	B	Yes
DTC P0125 (16) Engine Coolant Temperature (ECT) Excessive Time to Closed Loop Fuel Control	A	Yes
DTC P0131 (44) HO2S Circuit Low Voltage Bank 1 Sensor 1	B	Yes
DTC P0132 (45) HO2S Circuit High Voltage Bank 1 Sensor 1	B	Yes
DTC P0134 (42) HO2S Circuit Insufficient Activity Bank 1 Sensor 1	B	Yes
DTC P0135 (43) HO2S Heater Performance Bank 1 Sensor 1	A	Yes
DTC P0151 (64) HO2S Circuit Low Voltage Bank 2 Sensor 1	B	Yes
DTC P0152 (65) HO2S Circuit High Voltage Bank 2 Sensor 1	B	Yes
DTC P0154 (63) HO2S Circuit Insufficient Activity Bank 2 Sensor 1	B	Yes
DTC P0155 (62) HO2S Heater Performance Bank 2 Sensor 1	A	Yes
DTC P0171 (55) Fuel Trim System Lean	B	Yes
DTC P0172 (56) Fuel Trim System Rich	B	Yes
DTC P0336 (41) Crankshaft Position (CKP) Sensor Performance	A	Yes
DTC P0500 (24) Vehicle Speed Sensor (VSS) Circuit	B	Yes
DTC P0601 (58) AF ECM Internal Failure	A	Yes
DTC P1215 (27) Quad Driver Output Circuit	B	Yes

Alternative Fuels (AF) Powertrain OBD System Check

Circuit Description

The On-Board Diagnostic (OBD) System Check is an organized approach to identifying a problem created by a control module system malfunction. The OBD is the starting point for any driveability concern diagnosis. The OBD directs the service technician to the next logical step in diagnosing the concern. This system check will address possible faults in two separate control module systems. To avoid unnecessary diagnostic time, follow the system check carefully.

Perform this check **ONLY** if there is a driveability complaint or if you have been sent to this system check from another section in the service information.

Understanding the table properly reduces the diagnostic time. Proper use of the OBD helps prevent the unnecessary replacement of good parts.

Diagnostic Aids

Important!

- Do not clear DTCs unless directed by a diagnostic procedure. Clearing the DTCs will also clear valuable Freeze Frame and Failure Records data.
- If the AF ECM has stored DTC P0601 (DTC 58) along with multiple DTCs, go to *DTC P0601 (DTC 58) AF ECM Internal Failure* first. Intermittent power or ground connections may cause the AF ECM to store multiple false codes. Refer to *Engine Controls Schematics.*

Inspect all related wiring and connections including the connections at the PCM. These may cause an intermittent malfunction.

Check any circuitry that is suspected of causing an intermittent condition for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness
- Corrosion

Test Description (with Scan Tool)

The numbers below refer to the step numbers on the diagnostic table.

1. This step verifies that the MIL is functioning.
2. This step determines if the scan tool can communicate with the PCM.
3. This step determines if the scan tool can communicate with the AF ECM.
6. This step verifies that the engine will start.
7. Comparison of an actual control system data with the Typical Scan Tool Data Values is a quick check to determine if any parameter is not within limits. A base engine problem (i.e., advanced cam timing) may substantially alter sensor value.

Alternative Fuel (AF) Powertrain OBD System Check (with Scan Tool)

Step	Action	Value(s)	Yes	No
1	**Important!** • Check for applicable service bulletins before proceeding with this test. • Do not clear DTCs unless instructed by this diagnostic. 1. Turn off the ignition. 2. Connect the scan tool. 3. Turn ON the ignition with the engine OFF. Does the MIL illuminate?	—	Go to *Step 2*	Go to *Malfunction Indicator Lamp Circuit*

Step	Action	Value(s)	Yes	No
2	Using a scan tool, attempt to communicate and retrieve data from the PCM. If the scan tool fails to turn ON, refer to *Test Descriptions.* Does the scan tool display PCM data?	—	Go to *Step 3*	*Go to A Power train On-Board Diagnostic (OBD) System Check in the GM G Van service manual*
3	Using a scan tool, attempt to communicate and retrieve data from the AF ECM. Does the scan tool display AF ECM data?	—	Go to *Step 4*	Go to *Step 8*
4	1. Inspect both the PCM and the AF ECM for stored DTCs. 2. If any DTCs are set, record and store the DTC Freeze Frame and Failure Records information. Were any DTCs stored?	—	Go to *Step 9*	Go to *Step 5*
5	Command the MIL OFF using the scan tool Engine Output (PCM) for the MIL. Does the MIL turn OFF?	—	Go to *Step 6*	Go to *Malfunction Indicator Lamp Circuit*
6	Crank the engine for 10 seconds. Does the engine start?	—	Go to *Step 7*	Go to *No Start* in *Symptoms*
7	1. Operate the vehicle and observe/record the engine data parameters. 2. Compare the engine data on the scan tool with the *Engine Scan Tool Data List.* Are values normal or within typical range?	—	Go to *Step 10*	Go to the applicable DTC table
8	1. Check the Class 2 serial data circuit for an open or poor connection between the AF ECM and the serial data circuit splice. 2. Check battery power, ignition power and ground to the AF ECM. Refer to *Engine Controls Schematics.* 3. Repair circuits as necessary. Was a circuit or terminal connection repair made?	—	Go to *Step 12*	Go to *Step 11*

Step	Action	Value(s)	Yes	No
9	1. Compare the stored PCM DTCs to the stored AF ECM DTCs. 2. Diagnose DTCs in the following order: • If a DTC is stored ONLY in the PCM, refer to the applicable DTC table in the GM G Van service manual. • If a DTC is stored in BOTH control modules or only in the AF ECM, refer to the applicable DTC table in this manual. • If DIFFERENT multiple DTCs are stored, diagnose the PCM DTCs first. **Important!** If DTC P0601 (DTC 58) is stored along with different multiple DTCs, refer to *Diagnostic Aids* before going to the applicable DTC table. 3. Diagnose DTCs. Have all stored DTCs been diagnosed?	—	Go to *Step 12*	*Go to the applicable DTC Table*
10	Is there a driveability symptom?	—	Go to *Symptoms*	Go to *Step 12*
11	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 12*	—
12	1. Remove all test equipment except the scan tool. 2. Using a scan tool, clear DTC information from the PCM and the AF ECM. 3. Turn the ignition OFF and wait 30 seconds. 4. Start the engine and operate the vehicle. If a DTC was set, ensure that the operation of the vehicle allows the DTC to test. Refer to Conditions for running the DTC. 5. Observe the MIL. 6. Observe vehicle performance and driveability. 7. After operating the vehicle, inspect the PCM and the AF ECM for stored DTCs. Does the vehicle operate with normal performance and driveability with no stored DTCs?	—	System OK	Go to *Step 1*

Test Description (without Scan Tool)

The numbers below refer to the step numbers on the diagnostic table.

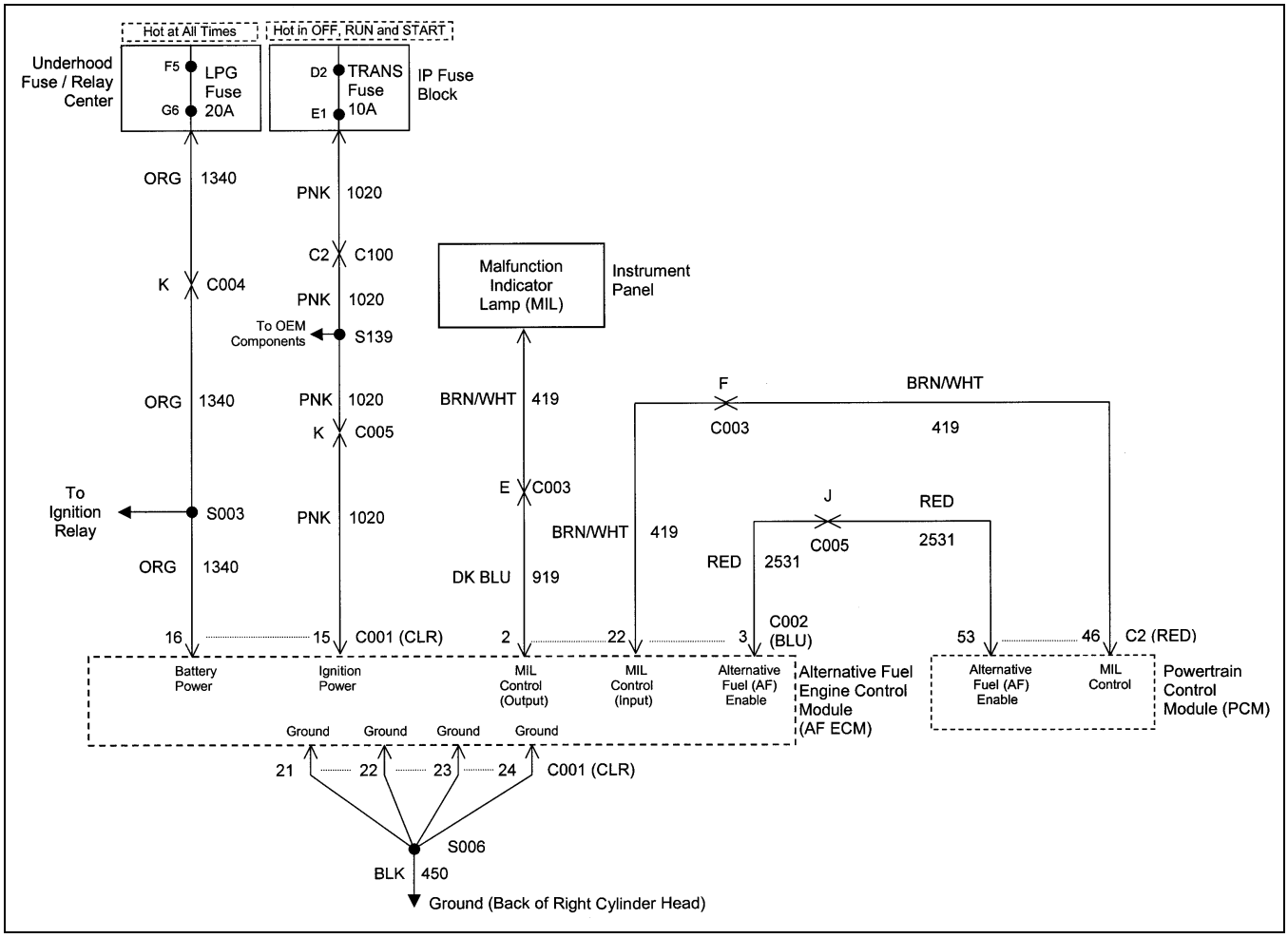
1. This step verifies operation of the MIL.
3. This step enables the AF ECM to display any stored codes.
5. This step will clear all AF ECM DTCs and reset fuel trim (block learn) to its initial value.

Alternative Fuel (AF) Powertrain OBD System Check (without Scan Tool)

Step	Action	Value(s)	Yes	No
1	**Important!** • Check for applicable service bulletins before proceeding with this test. • Do not clear DTCs unless instructed by this diagnostic. Turn ON the ignition with the engine OFF. Does the MIL illuminate?	—	Go to *Step 2*	Go to *Malfunction Indicator Lamp Circuit*
2	Turn the ignition switch OFF and wait ten seconds. Is the action complete?	—	Go to *Step 3*	—
3	Turn the ignition switch from OFF to RUN 3 times within 10 seconds leaving the key in the RUN position. Does the Wait to Drive light begin to flash DTCs?	—	Go to *Step 4*	Go to *Malfunction Indicator Lamp Circuit*
4	**Important!** • All DTCs are two digits. • All DTCs will be flashed 3 times before proceeding to the next DTC. • DTC 12 will always be present and indicates the ECM is in diagnostic retrieval mode. • All codes have been displayed when DTC 12 is flashed again. • If DTC P0601 (DTC 58) is stored along with multiple DTCs, refer to *Diagnostic Aids* before going to the applicable DTC table. Observe and record any DTCs. Were any DTCs (other than DTC 12) stored in the AF ECM?	—	Go to *Step 5*	Go to *Step 6*

5	Before going to the applicable DTC table, while in AF ECM DTC retrieval mode turn ignition from OFF to ON 3 additional times and wait 10 seconds after the MIL turns off before turning ignition off. This will clear all AF ECM DTCs and reset fuel trim. **Important!** If the ignition switch is not cycled OFF for 10 seconds after clearing any DTC(s) and the vehicle is started, the AF ECM OBD system will be disabled for that key cycle. Is the action complete?	—	Go to the Applicable DTC Table	—
6	Crank the engine for 10 seconds. Does the engine start?	—	Go to *Step 7*	Go to *No Start* in *Symptoms*
7	Observe the MIL. Is the MIL ON?	—	Go to *A Power train On-Board Diagnostic System Check* in the GM G Van service manual	Go to *Step 8*
8	Is there a driveability complaint?	—	Go to *Symptoms*	System OK

Malfunction Indicator Lamp Circuit



Circuit Description

The SERVICE ENGINE SOON Malfunction Indicator Lamp is used to indicate to the driver that an engine control system malfunction has occurred that may cause an increase in emissions and/or a driveability concern.

When the ignition is first turned ON, the PCM will illuminate the MIL for a bulb and system check. When the engine is started and operating, the PCM will turn the MIL OFF if no DTCs are set.

The AF ECM connects into the normal MIL control circuit path and does not affect the PCM of the MIL. The AF ECM is connected into the MIL control circuit path to command the MIL ON if a LPG DTC sets. Both the AF ECM and the PCM simultaneously test certain DTCs and may illuminate the MIL.

The IP gauge fuse supplies the positive voltage for the MIL. The PCM and/or the AF ECM can supply the ground path.

Diagnostic Aids

Using a scan tool, the AF ECM output driver data will display AF ECM MIL control status while the engine is cranking or running.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1. The AF Powertrain On-Board Diagnostic System Check must be performed before proceeding with this diagnostic table. Failure to perform the OBD System Check will result in misdiagnosis.
2. With the ignition ON and the engine OFF, the PCM should continuously illuminate the MIL.
3. The scan tool will command BOTH the PCM and the AF ECM to turn the MIL OFF.
5. This steps tests id the MIL Input circuit is requesting MIL illumination. There should not be a MIL Input while the MIL is commanded OFF.

6. This step checks if a PCM system failure is the cause of the inoperative MIL and a no start is a loss of voltage to the PCM.
8. This step tests for an open MIL Input circuit. The PCM should always command the MIL ON when the ignition is ON and the engine is OFF.
9. This step test for an open MIL Control circuit or IP.

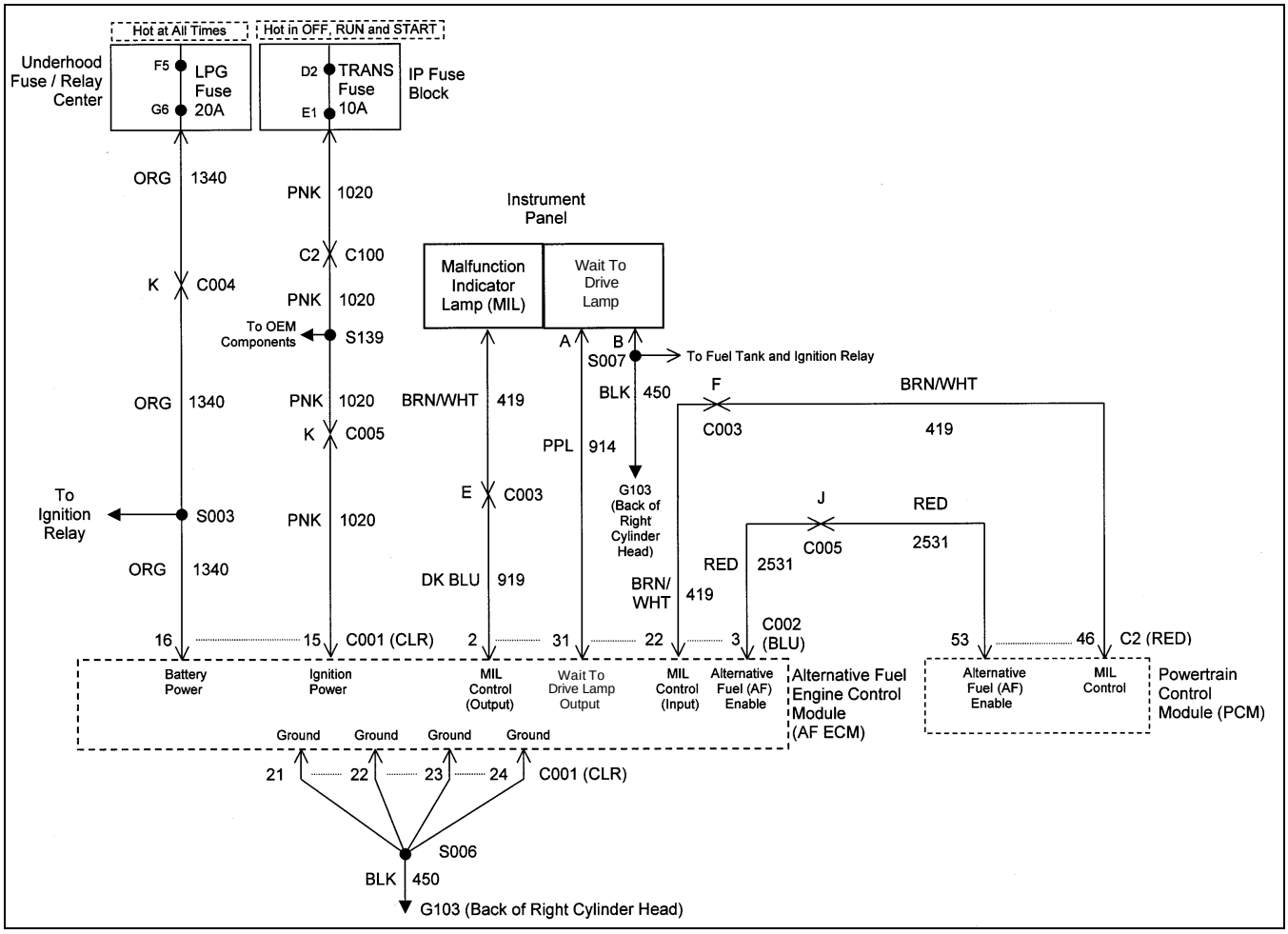
Malfunction Indicator Lamp Circuit

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Turn ON the ignition with the engine OFF. Is the he MIL continuously illuminated?	—	Go to *Step 3*	Go to *Step 6*
3	1. Connect a scan tool. 2. While communicating with the AF ECM, command the MIL OFF. Is the MIL illuminated?	—	Go to *Step 5*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Is an operational concern still present?	—	Go to *AF Powertrain OBD System Check*	Go to *Intermittents*
5	Observe the MIL input (PCM) data parameter on the scan tool with the MIL commanded OFF. Is a PCM MIL input request present?	—	Go to *Step 12*	Go to *Step 11*
6	Crank the engine for at least 10 seconds. Does the engine start and run?	—	Go to *Step 7*	Go to *Step 10*
7	Observe the operation of the other instrument panel (IP) gauges and/or lamps. Do all the IP indicators (except the MIL) operate correctly?	—	Go to *Step 8*	Go to *Step 16*
8	1. Turn ON the ignition with the engine OFF. 2. Observe the MIL Input (PCM) data parameter on the scan tool. Is a PCM MIL Input request present?	—	Go to *Step 9*	Go to *Step 14*
9	1. Turn OFF the ignition and wait 30 seconds. 2. Disconnect the AF ECM connectors. 3. Turn ON the ignition with the engine OFF. 4. Connect a fused jumper between the Mil Control (AF ECM) circuit terminal and a known good ground. If the jumper fuse opens, repair the short to voltage in the AF ECM MIL Control circuit. Is the MIL illuminated?	—	Go to *Step 17*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
10	The fault is in PCM system. Refer to *Powertrain On-Board Diagnostic System Check* in the G Van Truck service manual. Are all diagnosis and repairs of the OEM PCM system complete?	—	Go to *Step 20*	—
11	1. Test the MIL Control circuit between the AF ECM connector terminal and the IP for a short to ground. 2. Test the IP for an internally shorted condition. 3. Repair the circuit or IP as necessary. Was a repair necessary?	—	Go to *Step 20*	Go to *Step 17*
12	1. Test the MIL input circuit between the AF ECM connector terminal and the PCM connector terminal for a short to ground. 2. Repair the circuit as necessary. Was as circuit repair necessary?	—	Go to *Step 20*	Go to *Step 19*
13	1. Test the MIL Control circuit between the AF ECM connector terminal and the IP for an open. 2. Repair the circuit as necessary. Was a circuit repair necessary?	—	Go to *Step 20*	Go to *Step 16*
14	1. Test the MIL Input circuit between the AF ECM connector terminal and the PCM for an open or short to voltage. 2. Repair the circuit as necessary. Was a circuit repair necessary?	—	Go to *Step 20*	Go to *Step 15*
15	1. Check the terminal contact at the PCM connector. 2. Repair terminal contact as necessary. Was a terminal repair necessary?	—	Go to *Step 20*	Go to *Step 18*
16	The fault is in the instrument panel. Refer to *Instrument Cluster System Check* in Body and Accessories in the GM G Van service manual. Is the diagnosis and repair of the base vehicle system complete?	—	Go to *Step 20*	—
17	1. Check terminal contact at the AF ECM connector. 2. Repair terminal contact as necessary. Was a terminal repair necessary?	—	Go to *Step 20*	Go to *Step 19*

Step	Action	Value(s)	Yes	No
18	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 20*	—
19	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 20*	—
20	1. Remove all test equipment except the scan tool. 2. Connect any dis-connected components, fuses, etc. 3. Using a scan tool, clear DTC information from the AF ECM and the PCM. 4. Turn OFF the ignition and wait 30 seconds. 5. Start the engine and operate the vehicle. 6. Observe the MIL. 7. Observe vehicle performance and driveability. 8. After operating the vehicle, inspect the AF ECM and the PCM for stored DTCs. Does the vehicle operate normally with no stored DTCs?	—	System OK	Go to *AF Powertrain OBD System Check*

Wait to Drive Lamp Circuit



Circuit Description

The Wait to Drive (WTD) lamp circuit is controlled by the AF ECM and has two functions:

1. The WTD lamp is used to indicate to the driver that the LPG fuel system is below a minimum operating temperature. Before attempting to drive, the vehicle MUST BE WARMED UP until the WTD lamp is OFF.
2. The AF ECM OBD Powertrain System Check can be initialized to command two-digit OBD “blink codes” to be displayed by the WTD lamp.

Using a scan tool, the AF ECM output driver data will display WTD lamp control status while the engine is cranking or running.

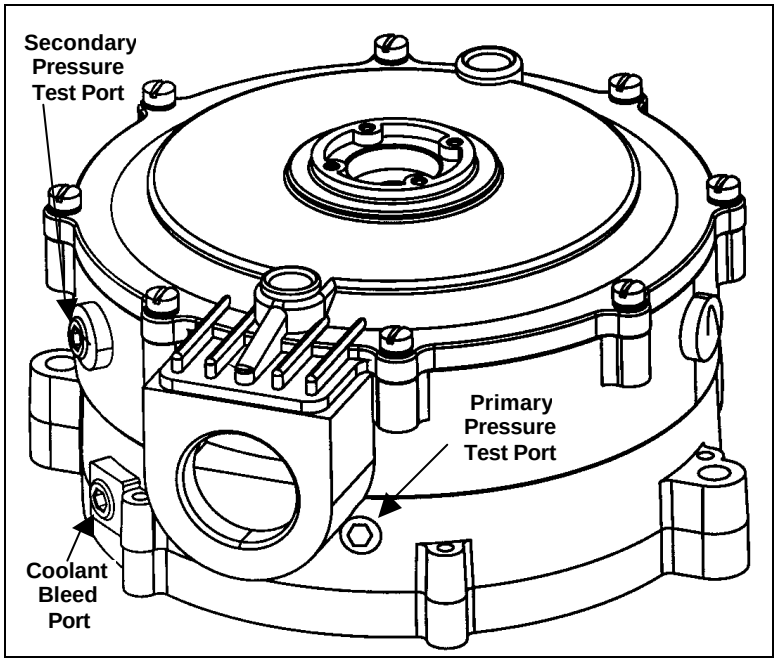
Wait to Drive Lamp Circuit

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Turn ON the ignition with the engine OFF. Is the WTD lamp continuously illuminated?	—	Go to *Step 3*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
3	1. Connect a scan tool. 2. While communicating with the AF ECM, command the WTD lamp OFF. Is the WTD lamp illuminated?	—	Go to *Step 5*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Is an operational concern still present?	—	Go to *AF Powertrain OBD System Check*	Go to *Intermittents*
5	Start the engine and allow to warm-up until the ECT sensor reading is above 40° C. Is the WTD lamp illuminated?	—	Go to *Step 6*	Go to *Intermittents*
6	1. Test the WTD lamp control circuit between the AF ECM connector terminal and WTD lamp for a short to ground. 2. Repair the circuit as necessary. Was as circuit repair necessary?	—	Go to *Step 13*	Go to *Step 7*
7	Test the AF ECM for a short to ground on C002 pin 31. Was a problem found?	—	Go to *Step 12*	Go to *Step 11*
8	1. Connect a scan tool. 2. While communicating with the AF ECM, command the WTD lamp ON. Is the WTD lamp illuminated?	—	Go to *Intermittents*	Go to *Step 9*
9	1. Test the WTD Control circuit between the AF ECM connector terminal and the WTD lamp for an open or short to power. 2. Repair the circuit as necessary. Was as circuit repair necessary?	—	Go to *Step 13*	Go to *Step 10*
10	1. Test the WTD lamp ignition power circuit for a short to ground or an open. 2. Repair the circuit as necessary. Was a circuit repair necessary?	—	Go to *Step 13*	Go to *Step 10*
11	Replace the WTD lamp assembly. Is the action complete?	—	Go to *Step 13*	—
12	Replace the AF ECM. *Refer to AF ECM Replacement.* Is the action complete?	—	Go to *Step 13*	—

Step	Action	Value(s)	Yes	No
13	1. Remove all test equipment 2. Connect any disconnected components, fuses, etc. 3. Using a scan tool, clear DTC information from the AF ECM and the PCM. 4. Start the engine and operate the vehicle. 5. Observe the WTD lamp. 6. Observe vehicle performance and driveability. 7. After operating the vehicle, inspect the AF ECM and the PCM for stored DTCs. Does the vehicle operate normally with no stored DTCs?	—	System OK	Go to *AF Powertrain OBD System Check*

AF Fuel System Diagnosis



Fuel System Description

The alternative fuel engine control module (AF ECM) receives information from various engine sensors in order to control the operation of the fuel and idle control valves and the underhood low pressure lock-off (LPL) solenoid. The fuel tank lock-off and underhood LPL solenoids prevent fuel flow unless the engine is cranking or running. LPG is stored in the tank and delivered under pressure to the system as a liquid. During key ON, the fuel tank lock-off receives a two (2) second prime pulse from the OEM fuel pump circuit. LPG flows from the tank through the fuel filter and fuel lines at pressures up to 312 psi to the underhood LPL.

When the engine is cranking or running, both lock-offs open and LPG flows into the low pressure regulator (LPR) where the fuel is vaporized and the pressure reduced in two stages. The first stage reduces the pressure to approximately 2.5 psi. The second stage reduces the pressure to approximately negative 1.8" of water column.

A vacuum generated by air flowing through the mixer then draws the fuel from the secondary chamber of the LPR. This vacuum signal is also used to generate lift for the mixer air valve. This vacuum signal is most commonly referred to as air valve vacuum. In the mixer, the fuel mixes with the air entering the engine. This air/fuel mixture is then drawn into the engine for combustion.

Diagnostic Aids

This procedure is intended to diagnose a vehicle operating on LPG. If the vehicle will not continue to run on LPG, refer to *Hard Start* for preliminary checks. Before proceeding with this procedure, verify that the vehicle has a sufficient quantity of fuel and that liquid fuel is being delivered to the LPR. Also, ensure that the manual shut off override valve on the LPG tank is fully opened and that the excess flow valve has not been activated. Verify air has been bled from the cooling system at the coolant bleed port.

Tools Required:

- Allen wrench (for test port plugs)
- DVOM (GM J 39200, Fluke 88 or equivalent).

Duty Cycle Monitoring Tool

- QUANTUM Fuel System Analyzer (FSA), or DVOM (GM J 39200, Fluke 88 or equivalent).

Diagnostic Scan Tool

- GM Tech 2 or equivalent.

Pressure Gauges

- Water Column Gauge / Manometer (GM 7333-6 or equivalent).
- 0-10 PSI Gauge

Test Description

The numbers below refer to step numbers on the diagnostic table.

5. This step will determine if the fuel control solenoid (FCS) and fuel supply system are functioning properly. The vacuum on the secondary test port will be approximately -2.0 "

to -4.0" w.c. If the vehicle has a hard start or poor idle, check for proper operation of the idle control solenoid (ICS).

6. This step checks the base mechanical LPR output pressure by disabling all fuel control devices.
9. This step checks for proper air valve operation.
19. This determines if fuel is available from the fuel tank supply system.

AF Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
1	Were you referred to this procedure by a DTC diagnostic chart?	—	Go to *Step 3*	Go to *Step 2*
2	Perform the AF On Board Diagnostic (OBD) System Check. Are any DTCs present in the AF ECM?	—	Go to the applicable DTC Table	Go to *Step 3*
3	Verify that the LPG fuel tank has a minimum of 1/4 tank of fuel. Does the vehicle have fuel?	—	Go to *Step 4*	—
4	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Start the engine and allow it to reach operating temperature. Does the engine start and run?	—	Go to *Step 5*	Go to *Step 8*
5	With the engine idling, observe the pressure reading for the LPR secondary pressure. Does the fuel pressure fluctuate rhythmically **OUTSIDE** the specified range?	-2.5" to -3.5" w.c.	Go to *Step 29*	Go to *Step 6*
6	1. Disconnect the ICS and FCS electrical connectors. **Note:** This action may cause a DTC to be set by the PCM or AF ECM 2. With the engine idling observe the pressure reading on the secondary test port. Is the fuel pressure **WITHIN** the specified range?	-1.5" to -2.0" w.c.	Go to *AF Fuel Control System Diagnosis*	Go to *Step 7*
7	1. Inspect the air intake stream between the mixer assembly and the throttle body for leaks. 2. Inspect the vacuum hoses in the mixer area for proper connection and condition. 3. Inspect the fuel hose connection between the LPR and mixer assembly for damage or leakage. 4. Inspect the vacuum hoses to the ETC solenoid. Was a problem found and corrected?	—	Go to *Step 30*	Go to *Step 26*

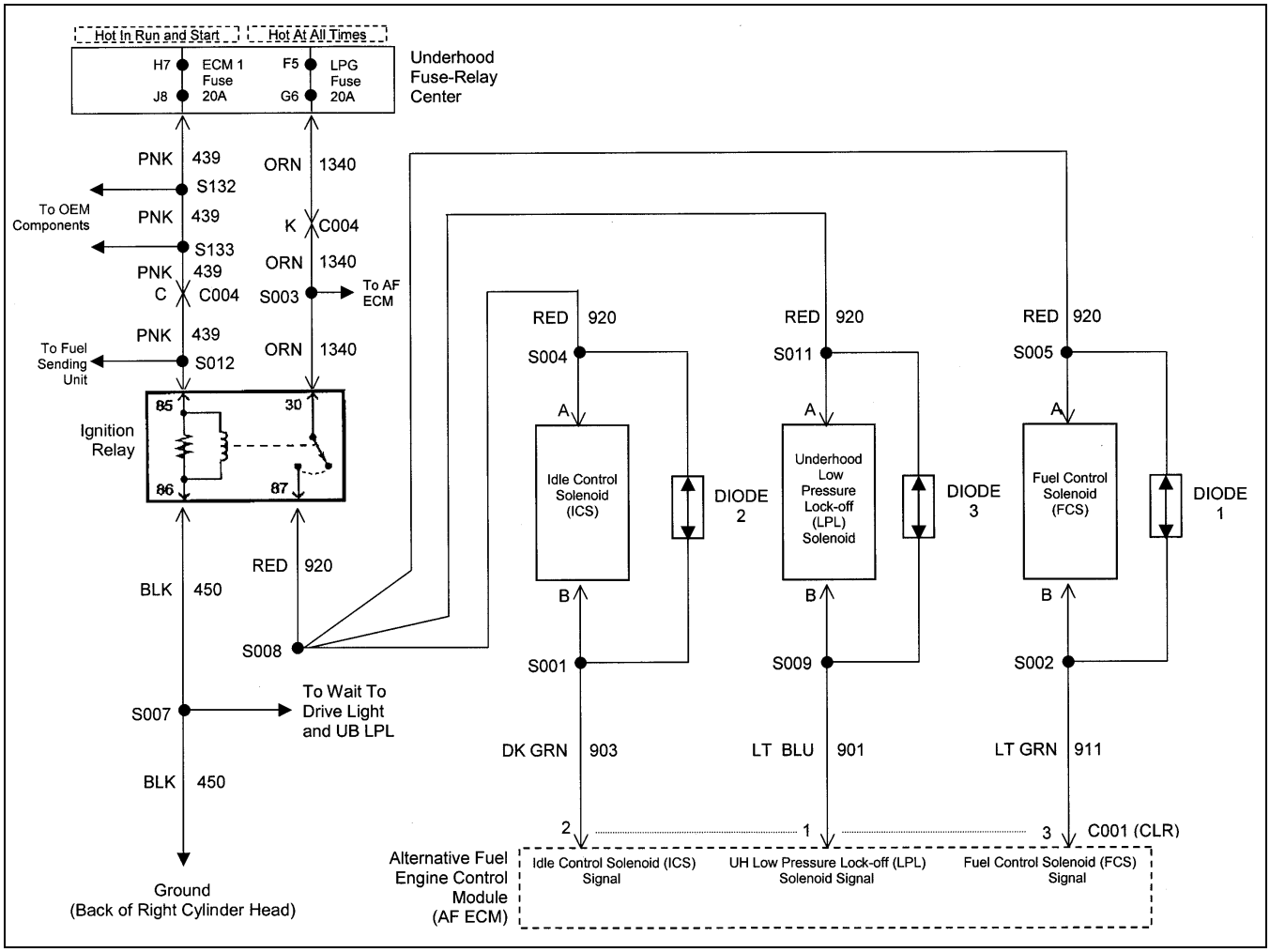
Step	Action	Value(s)	Yes	No
8	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR secondary pressure. Does the fuel pressure indicate a vacuum is present?	—	Go to *Step 12*	Go to *Step 9*
9	1. Inspect the air intake stream between the mixer assembly and the throttle body for vacuum leaks. 2. Inspect the vacuum hoses from the mixer to the FCS and ICS for proper connection and condition. Was a problem found and repaired?	—	Go to *Step 30*	Go to *Step 10*
10	Inspect the fuel hose connection between the LPR and the mixer assembly for damage or leakage. Was a problem found and repaired?	—	Go to *Step 30*	Go to *Step 11*
11	1. Remove the mixer and elbow assembly 2. Remove the mixer cover and check the air valve for sticking, binding or foreign debris. Was a problem found and repaired?	—	Go to *Step 30*	Go to *Step 28*
12	1. Connect a 0-10 psi gauge to the primary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR primary pressure. Is the fuel pressure **ABOVE** the specified value?	3.5 psi	Go to *Step 26*	Go to *Step 13*
13	1. Turn OFF the ignition. 2. Disconnect the underhood LPL connector. 3. Install a test light between the pins of the LPL connector. 4. Crank the engine. The test light should illuminate. Does the test light illuminate?	—	Go to *Step 14*	Go to *Step 16*
14	Using a DVOM, check the resistance of the underhood low pressure lock-off (LPL). Is the resistance within the specified range?	12 Ω - 16 Ω	Go to *Step 15*	Go to *Step 27*

Step	Action	Value(s)	Yes	No
15	1. Turn the ignition OFF. 2. Close the manual shut-off override valve on the LPG fuel tank lock-off solenoid. **CAUTION: When disconnecting LPG fuel lines, liquid LPG may be present. Perform this step in a well ventilated area.** 3. Loosen the fuel inlet hose fitting at the inlet of the underhood LPL. Was fuel present when the fitting was loosened?	—	Go to *Step 27*	Go to *Step 17*
16	1. Turn OFF the ignition. 2. Connect the test light to chassis ground and probe pin A of the LPL connector. 3. Crank the engine. The test light should illuminate. Does the test light illuminate?	—	Go to *Step 24*	Go to *Step 25*
17	1. Disconnect the fuel tank lock-off connector. 2. Install a test light between the pins of the LPL connector. 3. Turn the ignition ON. The test light should illuminate for 2 seconds. Does the test light illuminate?	—	Go to *Step 18*	Go to *Step 23*
18	Using a DVOM, check the resistance of the fuel tank lock-off Is the resistance within the specified range?	16 Ω - 20 Ω	Go to *Step 19*	Go to *Step 27*
19	**CAUTION: When disconnecting LPG fuel lines, liquid LPG may be present. Perform this step in a well ventilated area.** 1. Loosen the fuel inlet hose fitting at the outlet of the fuel tank lock-off. Was fuel present when the fitting was loosened?	—	Go to *Step 21*	Go to *Step 27*
20	The fuel supply system or hoses are plugged or restricted. Locate and repair the problem. Is the action complete?	—	Go to *Step 30*	—

Step	Action	Value(s)	Yes	No
21	1. Remove the LPG fuel filter 2. Empty the contents of the inlet side of the LPG fuel filter onto a clean surface. 3. Inspect the contents of the LPG fuel filter for an excessive amount of foreign material or water. If necessary, locate and repair the source of contamination. 4. Verify the LPG fuel filter is not restricted or plugged. Was a problem found?	—	Go to *Step 22*	Go to *Step 20*
22	Replace the fuel filter. Refer to *Fuel Filter Replacement.* Is the action complete?	—	Go to *Step 30*	—
23	1. Turn OFF the ignition. 2. Connect the test light to chassis ground and probe pin A of the LPL connector. 3. Crank the engine. The test light should illuminate. Does the test light illuminate?	—	Go to *Step 24*	Go to *Step 25*
24	Repair the open in the lock-off ground circuit. Is the action complete?	—	Go to *Step 30*	—
25	Repair the open in the lock-off power (OEM fuel pump) circuit. Is the action complete?	—	Go to *Step 30*	—
26	Replace the low pressure regulator (LPR). Refer to *Low Pressure Regulator Replacement*. Is the action complete?	—	Go to *Step 30*	—
27	Replace the lock-off. Refer to applicable fuel tank or underhood *Low Pressure Lock-off (LPL) Replacement*. Is the action complete?	—	Go to *Step 30*	—
28	Replace the mixer and elbow assembly. Refer to *Fuel Mixer Replacement*. Is the action complete?	—	Go to *Step 30*	—

Step	Action	Value(s)	Yes	No
29	The fuel supply system is operating normally, if a failure of the control solenoids is suspected. Refer to *AF Fuel Control System Diagnosis.* 1. Install the test plug in the LPR secondary chamber. 2. If you were sent to this routine by another diagnostic chart, return to the previous diagnostic procedure. Is the action complete?	—	System OK	—
30	1. Disconnect all test equipment 2. Install the primary and secondary test port plugs. 3. Start the engine. 4. Using SNOOP® or equivalent, leak check the test port plugs. Is the action complete?	—	System OK	—

AF Fuel Control System Diagnosis



Fuel Control System Components

The main components of the fuel control system are:

- The alternative fuel engine control module (AF ECM)
- The low pressure regulator (LPR)
- The fuel mixer
- The fuel control solenoid (FCS)
- The idle control solenoid (ICS)

Fuel Control System Operation

The AF ECM receives information from various engine sensors in order to control the fuel and idle control valves to maintain closed loop operation. During normal operation the ECM commands a duty cycle to the fuel control solenoid (FCS). The FCS modulates air valve vacuum on top of the secondary diaphragm of the LPR. By controlling the pressure on top of the LPR secondary diaphragm, the ECM can control the output pressure and fuel flow to the mixer. A high FCS duty cycle means the ECM is issuing a lean command to control a rich condition. A low FCS duty cycle means the ECM is issuing a rich command to control a lean condition.

To increase fuel control authority, the ECM will also use the idle control solenoid (ICS). The ICS supplies additional fuel (from the LPR secondary chamber) below the mixer directly into the air stream. The ECM will always command a duty cycle to the ICS that is the opposite or the FCS. If the ECM commands an 80% duty cycle to the FCS, the ECM will command a 20% duty cycle to the ICS.

Diagnostic Aids

Always diagnose any PCM or ECM codes that are present before beginning this diagnostic procedure. Refer to *Important Preliminary checks* and *Symptom Diagnosis Charts* before attempting to diagnose the AF fuel control system. If the vehicle will not continue to run refer to *Hard Start* for preliminary checks. Before proceeding with this procedure, verify that the *AF Fuel System Diagnosis* has been performed.

Check for the following conditions:

- Loose, cracked or kinked vacuum hoses.
- Poor connection or a damaged harness to the AF ECM, FCS and ICS.
- Poor AF ECM engine block ground.
- Sticking mixer air valve.
- Intake air leak between mixer and throttle body.
- Faulty low pressure regulator (LPR).
- Exhaust leaks.
- Fuel contamination.
- Cooling system bled at LPR.

Tools Required:

- DVOM (GM J 39200, Fluke 88 or equivalent).

Duty Cycle Monitoring Tool

- DVOM (GM J 39200, Fluke 88 or equivalent).

Diagnostic Scan Tool

- GM Tech 2 or equivalent.

Pressure Gauges

- Water Column Gauge / Manometer (GM 7333-6 or equivalent).
- 0-10 PSI Gauge.

Test Description

The numbers below refer to step numbers on the diagnostic table.

4. This test determines proper fuel control system authority at idle.
7. This test determines proper fuel control system operation at 2500 RPM.

AF Fuel Control System Diagnosis

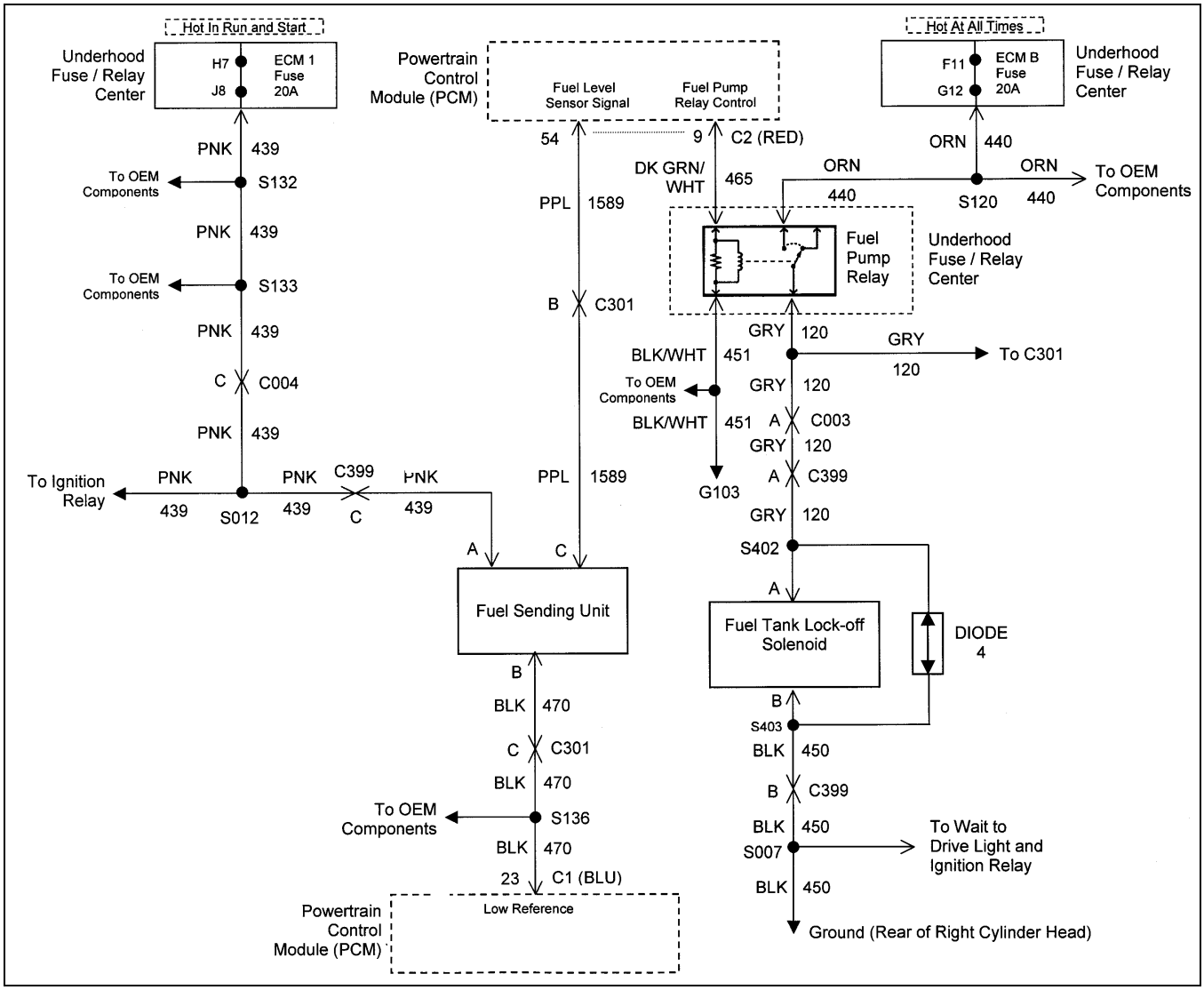
Step	Action	Value(s)	Yes	No
1	Were you referred to this procedure by another diagnostic chart?	—	Go to *Step 3*	Go to *Step 2*
2	Perform the AF On-Board Diagnostic (OBD) System Check. Are any DTCs present in the AF ECM?	—	Go to the applicable DTC Table	Go to *Step 3*
3	Has the *AF Fuel System Diagnosis* been performed?	—	Go to *Step 4*	Go to *AF Fuel System Diagnosis*
4	1. Connect a scan tool. 2. Start the engine and allow it to reach operating temperature. 3. With the engine idling, observe the duty cycle reading of the FCS on the scan tool Is the FCS duty cycle within the specified range?	20% to 80%	Go to *Step 6*	Go to *Step 5*
5	Is the FCS duty cycle below the specified value?	20%	Go to *Step 8*	Go to *Step 10*
6	Will the engine rev to 2500 RPM?	—	Go to *Step 7*	Go to *Step 11*
7	1. Observe the scan tool MAF reading. 2. Raise the engine speed to approximately 2500 RPM or greater than 28 g/s MAF. 3. Observe the duty cycle reading of the FCS. Is the FCS duty cycle within the specified range?	20% to 80%	Go to *Step 25*	Go to *Step 13*
8	1. With the engine idling, observe the duty cycle of the ICS on the scan tool. Is the ICS duty cycle **ABOVE** the specified range?	80%	Go to *Step 9*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
9	1. Using a DVOM, backprobe the ICS electrical connector terminals. 2. Observe the duty cycle of the ICS. Is the ICS duty cycle **ABOVE** the specified range?	80%	Go to *Step 19*	Go to *Step 12*
10	1. Observe the scan tool MAF reading. 2. Raise the engine speed to approximately 2500 RPM or greater than 28 g/s MAF. 3. Observe the duty cycle reading of the FCS. Is the FCS duty cycle within the specified range?	20% to 80%	Go to *Step 12*	Go to *Step 11*
11	1. Turn the engine OFF. 2. Disconnect the ECM connector C001. 3. Disconnect the FCS electrical connector. 4. Check the FCS ground circuit in terminal B (LT GRN) for continuity to the ECM connector. 5. Check the FCS ground circuit in terminal B (LT GRN) for short to ignition power or ground. Was a problem found and repaired?	—	Go to *Step 26*	Go to *Step 17*
12	1. Connect the positive lead of the DVOM to an ignition power source. 2. Backprobe the ICS connector pin B (DK GRN). 3. Connect the negative lead of the DVOM to terminal B. Is the ICS duty cycle ABOVE the specified range?	80%	Go to *Step 15*	Go to *Step 13*
13	1. Disconnect the ECM connector C001. 2. Check the ICS ground circuit between the ICS connector terminal B and C001 for an open or short to ignition power or ground. Was a problem found and repaired?	—	Go to *Step 26*	Go to *Step 14*
14	1. Disconnect ECM connector C001. 2. Turn the ignition ON leaving the engine OFF. 3. Check ECM cavity C001 pin 12 for a short to power. Was a problem found?	—	Go to *Step 16*	Go to *Step 20*
15	The ICS ignition circuit is open or shorted to ground. Check the ICS ignition circuit in the ICS connector terminal A for ignition power. Was a problem repaired?	—	Go to *Step 26*	—
16	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 18*	—

Step	Action	Value(s)	Yes	No
17	Check the vacuum hoses between the mixer, LPR,FCS and the ICS for kinks, obstructions or leakage. Was a problem found and repaired?	—	Go to *Step 26*	Go to *Step 21*
18	Repair the open or damaged circuit. Is the action complete?	—	Go to *Step 26*	—
19	Check the fuel hose between the LPR and the ICS for kinks or obstructions. Was a problem found and repaired?	—	Go to *Step 26*	Go to *Step 20*
20	Replace the Idle Control Solenoid (ICS). Refer to *Idle Control Solenoid Replacement.* Is the action complete?	—	Go to *Step 22*	—
21	Replace the fuel control solenoid (FCS). Refer to *Fuel Control Solenoid (FCS) Replacement*. Is the action complete?	—	Go to *Step 22*	—
22	1. Return the fuel system to normal operating condition. 2. Observe the scan tool MAF reading. 3. Raise the engine speed to approximately 2500 RPM or greater than 28 g/s MAF. 4. Observe the duty cycle reading of the FCS. Is the FCS duty cycle within the specified range?	20% to 80%	Go to *Step 26*	Go to *Step 23*
23	Check all vacuum hoses and mixer connections for leakage. Was a problem found and repaired?	—	Go to *Step 26*	Go to *Step 24*
24	Replace the fuel mixer. Refer to *Fuel Mixer Replacement.* Is the action complete?	—	Go to *Step 26*	—
25	The AF fuel control system is operating normally. Refer to *Symptoms Diagnosis.* 1. Disconnect all test equipment. 2. If you were sent to this routine by another diagnostic chart, return to the previous diagnostic procedure. Is the action complete?	—	System OK	—

Step	Action	Value(s)	Yes	No
26	1. Disconnect all test equipment. 2. Start the engine. 3. Using SNOOP® or equivalent, leak check any fuel system repairs made. Is the action complete?	—	System OK	—

LPG Fuel Sending Unit Diagnosis



Circuit Description

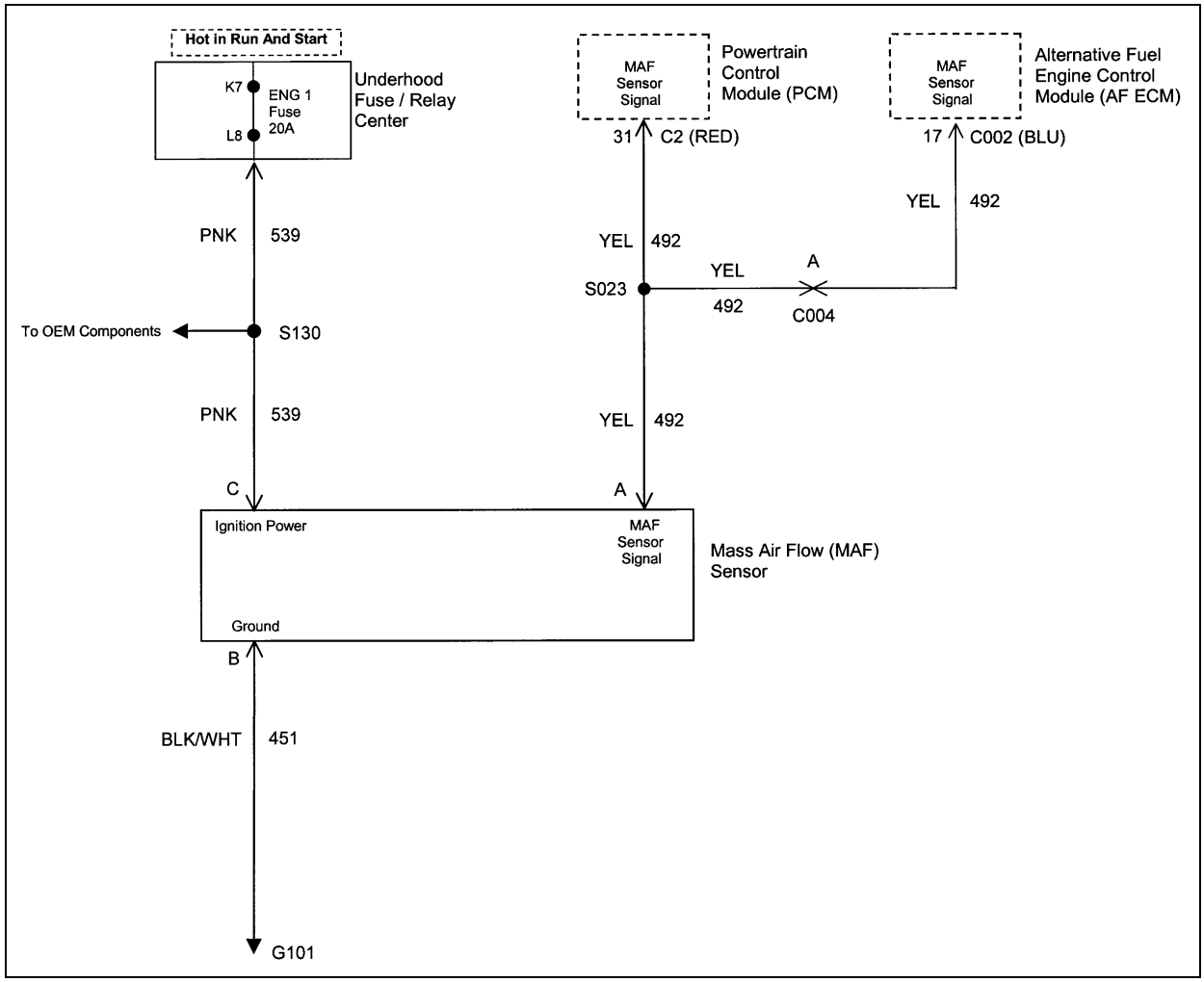
The LPG fuel sending unit (FSU) is mounted in the LPG tank assembly. The sensor is powered by 12 volts and outputs a digital signal through the fuel level sensor signal circuit to the PCM. The PCM drives the fuel gauge.

LPG Fuel Sending Unit Diagnosis

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Do all the other gauges on the instrument panel appear to function correctly?	—	Go to *Step 3*	Go to *Instrument Panel, Gauges and Console (Gas) in the* G-van Service Manual

Step	Action	Value(s)	Yes	No
3	Verify the LPG fuel level by filling until liquid appears at the liquid level gauge. Does the fuel gauge read full?	—	Go to *Intermittents*	Go to *Step 4*
4	1. Disconnect the FSU connector. 2. Connect DVOM across pins A and B. 3. Turn the ignition key ON. Is the voltage within the specified value?	9.6V – 13.5V	Go to *Step 6*	Go to *Step 5*
5	Connect the DVOM between a chassis ground and FSU connector pin A. Is the voltage within the specified value?	9.6V – 13.5V	Go to *Step 8*	Go to *Step 7*
6	1. Inspect the Fuel Level Sensor circuit between FSU connector pin C and AF connector C301 pin B for the following: • High resistance • Poor terminal contact • Opens • Shorts 2. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair made?	—	Go to *Step 10*	Go to *Step 9*
7	Repair the AF FSU power circuit. Is the action complete?	—	Go to *Step 10*	—
8	Repair the AF FSU ground circuit. Is the action complete?	—	Go to *Step 10*	—
9	Replace the fuel sending unit. Refer to *Fuel Sending Unit Replacement.* Does the fuel gauge read correctly?	—	Go to *Step 10*	Go to *Fuel Gauge Inaccurate or Inoperative (Gas)* in the G-van Service Manual
10	1. Disconnect all test equipment. 2. Start the engine. 3. Using SNOOP® or equivalent, leak check any fuel system repairs made. Is the action complete?	—	System OK	—

DTC P0102 (DTC 36) MAF Sensor Circuit Low Frequency



Circuit Description

The MAF sensor is an air flow meter. The MAF sensor is supplied with ignition voltage and a ground. The MAF sensor heats a wire grid within the sensor to a predetermined temperature. As inlet air flow across and cools the wire grid, the MAF sensor must increase current flow to the wire grid to maintain a constant temperature. The MAF sensor converts the required wire grid current flow into a frequency signal. The PCM and the AF ECM monitor the MAF signal circuit frequency and determine the flow and mass of the air entering the engine.

The PCM and the AF ECM convert the MAF signal circuit frequency into a grams per second value. During low air flow rates (such as at engine idle), the MAF sensor will produce a low frequency signal (around 2,000 Hz or 6 grams per second). During high air flow rates (such as wide open throttle with load), the MAF sensor will produce a high frequency signal (around 9000 Hz or 125 grams per second).

This DTC is used to indicate a MAF sensor frequency that is below the normal operating range of the sensor. This DTC is a type A DTC.

Conditions for Running the DTC

Cranking Test

- The engine is cranking but has not yet started.
- The battery voltage is greater than 8 volts.

Running Test

- Engine run time is greater than 10 seconds.
- Battery voltage is greater than 10 volts.
- Engine speed is greater than 500 RPM.

Conditions for Setting the DTC

Cranking Test

- The AF ECM monitors the MAF sensor signal of less than 125 Hz (0 gms/sec) for at least 0.5 seconds continuously.

Running Test

- The AF ECM monitors a MAF sensor signal of less than 1500 Hz (2.5 gms/sec) for al least 0.5 seconds continuously.

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History during ONE drive trip in which the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present

Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
6. This step determines if the proper MAF signal circuit voltage is available from the PCM.
10. This step test for proper MAF sensor ignition voltage and ground circuits.
11. This step determines if the MAF sensor ignition voltage circuit or the MAF sensor ground circuit is the cause of the condition.

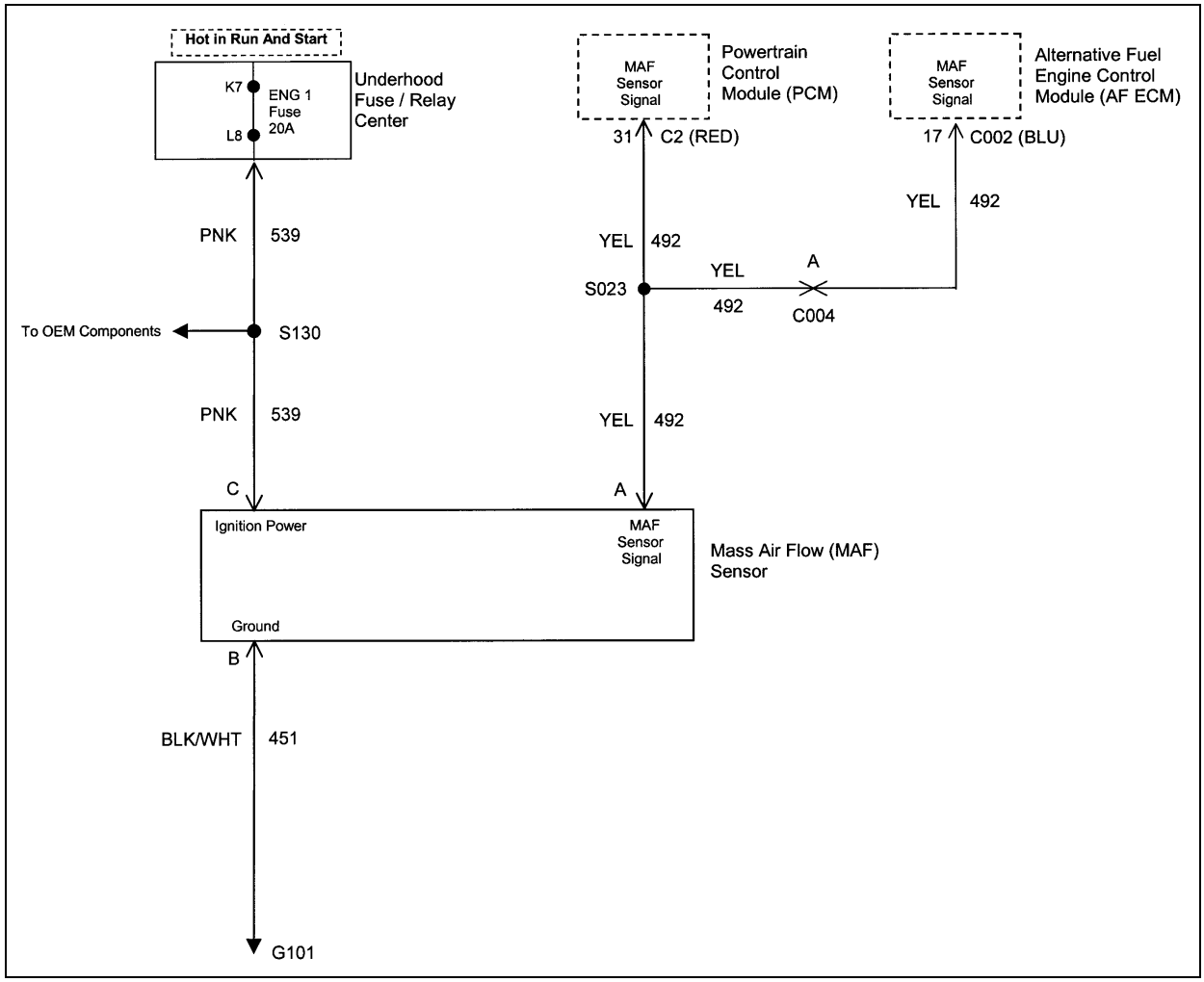
DTC P0102 (DTC 36) MAF Sensor Circuit Low Frequency

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Start the engine. 2. Using the scan tool, establish communication with the PCM. 3. Observe the MAF sensor data parameter. Does the MAF sensor data parameter indicate air flow less than the specified value?	2.2 gms/sec	Go to *Step 5*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the MAF sensor data parameter. Does the MAF sensor data parameter indicate airflow less than the specified value?	2.2 gms/sec	Go to *Step 9*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	Inspect the air intake system between the MAF sensor and the throttle body for leaks. Was a problem found and repaired?	—	Go to *Step 18*	Go to *Step 6*
6	1. Turn the engine OFF leaving the ignition ON. 2. Disconnect the MAF sensor connector. 3. Connect a DVOM between the MAF signal circuit and ground. Is the voltage near the specified value?	5.0 volts	Go to *Step 10*	Go to *Step 7*
7	1. Inspect the MAF sensor signal circuit for an open or high resistance between the sensor connector and the PCM. 2. If the circuit voltage is greater than 5.2 volts, inspect the MAF sensor signal circuit for a short to voltage. 3. Inspect for proper terminal contact at both the PCM and the MAP sensor connector. 4. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair necessary?	—	Go to *Step 18*	Go to *Step 8*
8	1. Inspect the MAF sensor signal circuit for a short to engine ground or to the sensor ground circuit. 2. Disconnect the AF ECM connector containing the MAF sensor signal circuit to determine if the AF ECM is the cause of the short. 3. Repair the wiring as necessary. Is a repair or replacement necessary?	—	Go to *Step 18*	Go to *Step 16*
9	1. Inspect the MAF sensor signal circuit for an open or high resistance between the circuit splice and the AF ECM connector. 2. Inspect for proper terminal contact at the AF ECM connector. 3. Repair wiring or terminal as necessary. Was a wiring or terminal repair necessary	—	Go to *Step 18*	Go to *Step 17*
10	Connect a test lamp between the ignition feed circuit terminal and the ground circuit terminal of the MAF sensor connector. Is the test lamp illuminated?	—	Go to *Step 14*	Go to *Step 11*
11	Connect a test lamp between the ignition feed circuit terminal of the MAF sensor connector and a known good ground. Is the test lamp illuminated?	—	Go to *Step 13*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
12	Repair the cause of no MAF sensor voltage. Possible causes include the following: • An open ignition fuse. • An open or shorted to ground (blown fuse) ignition feed circuit. • A shorted to ground (blown fuse) component that shares the MAF sensor ignition feed circuit. • Repair wiring or replace components as necessary. Is the repair complete?	—	Go to *Step 18*	—
13	Repair the open MAF sensor ground circuit. Is the repair complete?	—	Go to *Step 18*	—
14	1. Inspect the MAF sensor connector for proper terminal contact. 2. Repair terminal as necessary. Was a connector terminal repair made?	—	Go to *Step 18*	Go to *Step 15*
15	Replace the MAF sensor. Refer to *MAF Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 18*	—
16	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 18*	—
17	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 18*	—
18	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0103 (DTC 37) MAF Sensor Circuit High Frequency



Circuit Description

The MAF sensor is an air flow meter. The MAF sensor is supplied with ignition voltage and a ground. The MAF sensor heats a wire grid within the sensor to a predetermined temperature. As inlet air flow across and cools the wire grid, the MAF sensor must increase current flow to the wire grid to maintain a constant temperature. The MAF sensor converts the required wire grid current flow into a frequency signal. The PCM and the AF ECM monitor the MAF signal circuit frequency and determine the flow and mass of the air entering the engine.

The PCM and the AF ECM convert the MAF signal circuit frequency into a grams per second value. During low air flow rates (such as at engine idle), the MAF sensor will produce a low frequency signal (around 2,000 Hz or 6 grams per second). During high air flow rates (such as wide open throttle with load), the MAF sensor will produce a high frequency signal (around 9000 Hz or 125 grams per second).

This DTC is used to indicate a MAF sensor frequency that is above the normal operating range of the sensor. This DTC is a type A DTC.

Conditions for Running the DTC

Power-Up Test
- Battery voltage is greater than 10 volts.

Cranking Test
- The engine is cranking but has not yet started.
- The battery voltage is greater than 8 volts.

Running High Frequency Test
- The engine has been operating for greater than 10 seconds.
- Battery voltage is greater than 10 volts.
- Engine speed is greater than 500 RPM.

Conditions for Setting the DTC

All Tests

The AF ECM monitors a MAF signal of greater than 10,390 Hz for at least 0.5 seconds continuously.

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History during ONE drive trip in which the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
5. This step determines if the MAF sensor is generating the high frequency signal.
6. This step determines if the AF ECM is generating the high frequency signal.
7. This step determines if an external source is inducing a high frequency to the MAF signal circuit.

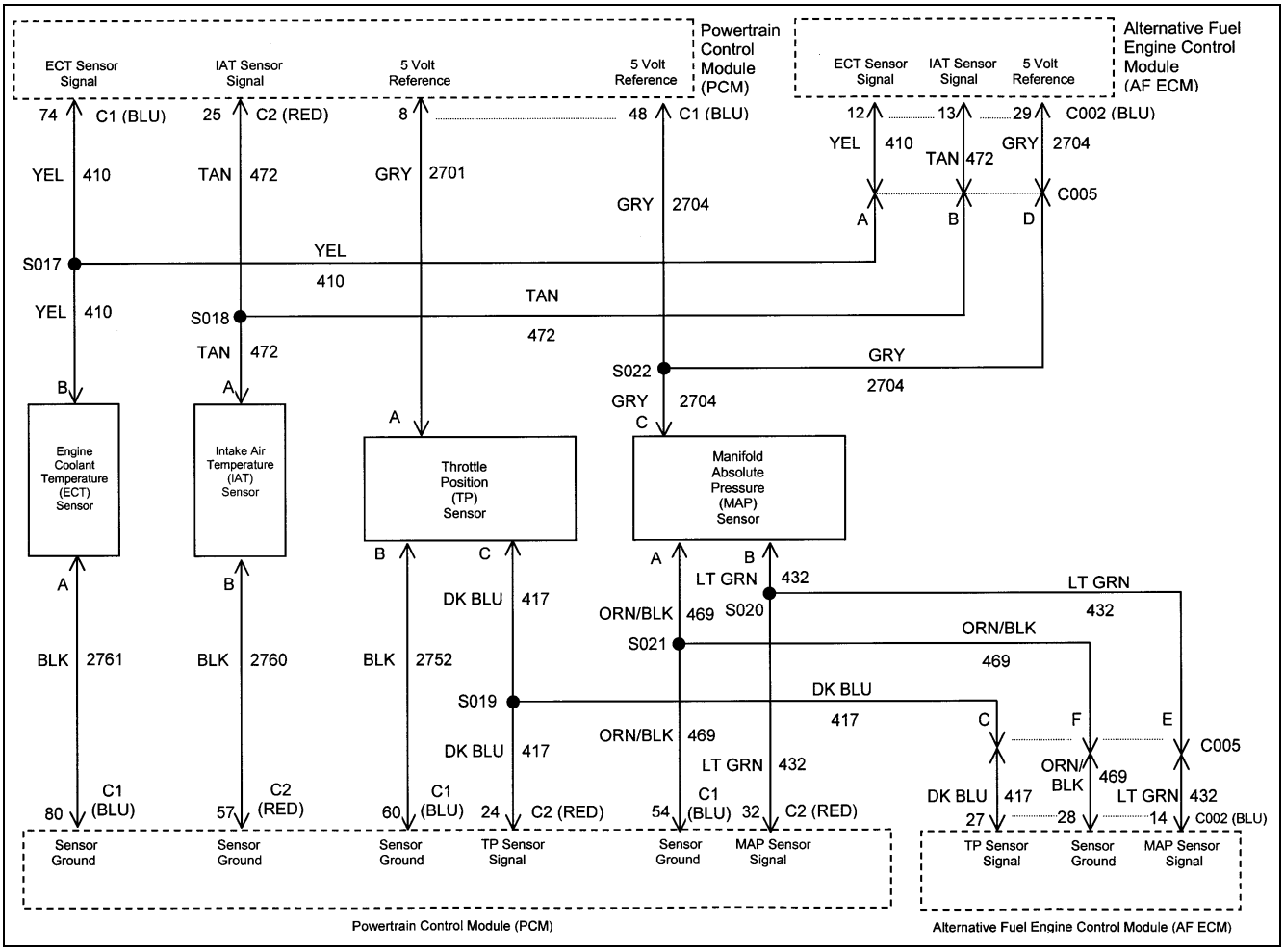
DTC P0103 (DTC 37) MAF Sensor Circuit High Frequency

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Start the engine. 2. Using the scan tool, establish communication with the PCM. 3. Observe the MAF sensor data parameter. Does the MAF sensor data parameter indicate frequency greater that the specified value?	4.50 kHz	Go to *Step 5*	Go to *Step 3*
3	1. Using the scan tool establish communication with the AF ECM. 2. Observe the MAF sensor data parameter. Does the MAF sensor data parameter indicate airflow greater than the specified value?	20 gms/sec	Go to *Step 10*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Disconnect the MAF sensor connector. 2. Observe the MAF sensor data parameter with the engine idling. Does the MAF sensor data parameter indicate frequency greater than the specified value?	0.0 kHz	Go to *Step 6*	Go to *Step 8*
6	1. Turn the ignition OFF. 2. Disconnect the AF ECM connectors. 3. Start and idle the engine. 4. Observe the MAF sensor data parameter with the engine idling. Does the MAF sensor data parameter indicate frequency greater than the specified value?	0.0 kHz	Go to *Step 7*	Go to *Step 10*
7	A high frequency signal may be induced on the MAF signal circuit by sources other than the MAF sensor. Inspect the vehicle for the following conditions: • A MAF signal circuit routed near secondary ignition components. • A MAF signal circuit routed near high current components (motors, relays, etc.). • High power transceivers operating in or near the vehicle. • Route wiring harness correctly or remove the source of high frequency. Was an induced high frequency source found and corrected?	—	Go to *Step 11*	Go to *Step 9*
8	Replace the MAF sensor. Refer to *MAF Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 11*	—
9	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 11*	—
10	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 11*	—

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0106 (DTC 32) MAP System Performance



Circuit Description

The manifold absolute pressure (MAP) sensor is a pressure sensor. The PCM supplies about 5 volts on the MAP sensor reference voltage circuit. The PCM also supplies a ground circuit to the MAP sensor. When manifold vacuum is low the MAP signal voltage rises to near 4.5 volts. As manifold vacuum increases the MAP signal voltage drops to around 1.0 volt. The PCM and the AF ECM monitor MAP signal voltage and determine the vacuum within the intake manifold.
The vehicle also uses the MAP sensor to determine the barometric pressure when the ignition switch is turned ON and the engine is NOT cranked. This BARO reading may also be updated whenever the engine is operated at wide open throttle.
This DTC is used to indicate a MAP sensor signal voltage that does not change when TP sensor voltage changes. This DTC is a type A DTC.

Conditions for Running the DTC

- The engine has been operating for greater than 5 seconds.
- No AF ECM DTCs are set.
- The TP sensor angle is less that 70 percent.

Conditions for Setting the DTC

The AF ECM monitors that the MAP sensor pressure changes less that 6 kPa when the TP sensor angle changes by greater that 20 percent.

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History during ONE drive trip that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.

- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. This step tests the MAP sensor's ability to correctly indicate BARO.

   To determine the correct MAP sensor display of BARO for any elevation, perform either of the following:
   Compare the recorded MAP sensor display value to the BARO display on a know good vehicle
   Or
   Obtain local weather service barometer reading (in Hg). Multiply the barometer reading by 3.4. The result indicates the correct BARO value for your area.

3. This step tests the MAP sensor's ability to correctly indicate engine vacuum.

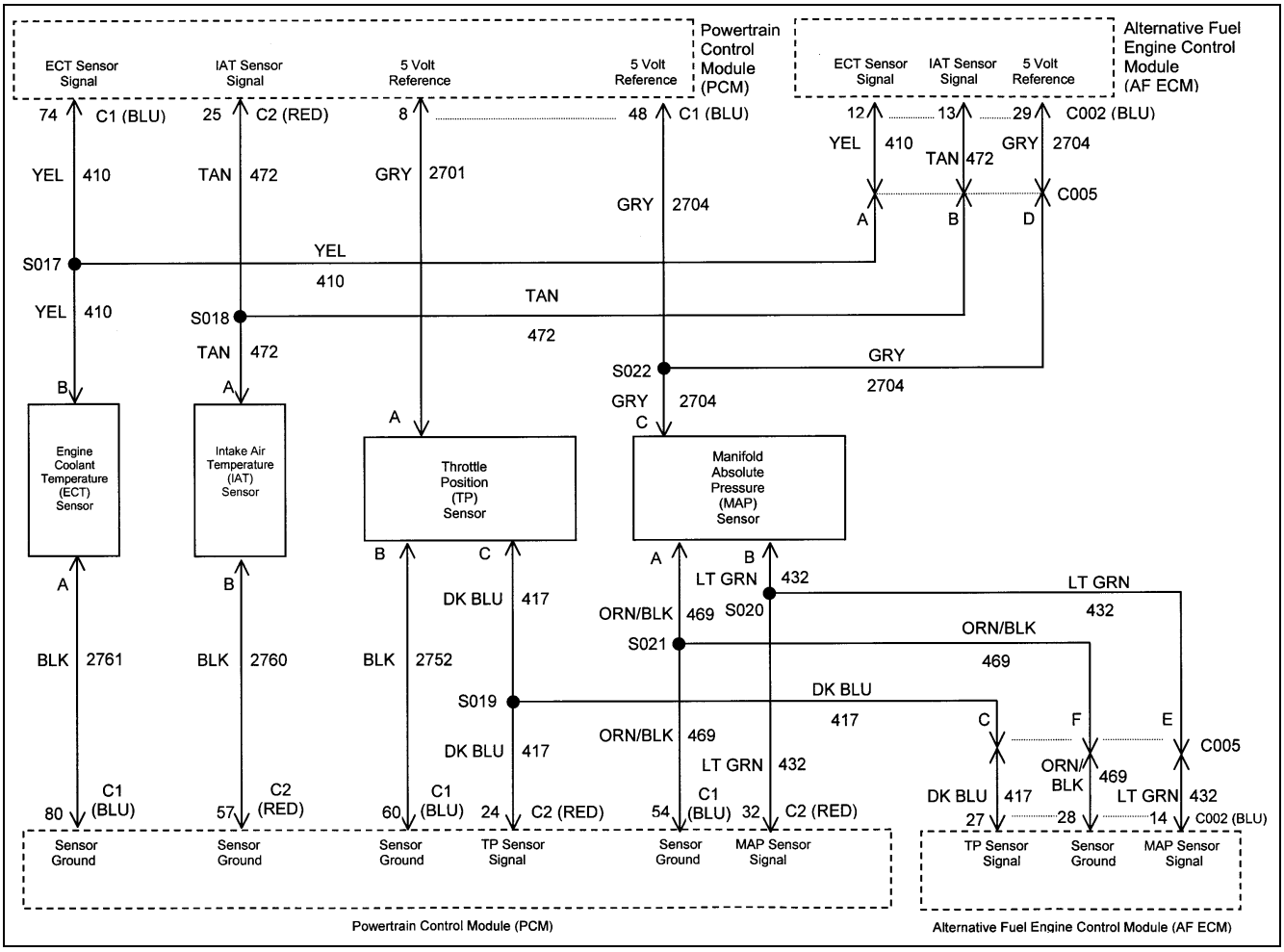
7. This step indicates this sensor is currently functioning correctly. If you were sent to this diagnostic procedure from other service information, return to that procedure now.

DTC P0106 (DTC 32) MAP System Performance

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Turn the ignition ON with the engine OFF. 2. Using the scan tool, establish communication with the AF ECM. 3. Observe and record the MAP sensor kPa display. Does the MAP sensor data parameter indicate MAP pressure greater than the specified value?	75 kPa@ altitude 95 kPa@ sea level	Go to *Step 3*	Go to *Step 8*
3	1. Remove the MAP sensor from the engine vacuum source. Leave the MAP sensor connected to the engine harness. 2. Connect a hand vacuum pump to the MAP sensor. 3. Observe the MAP sensor kPa as you SLOWLY apply vacuum (1" Hg at a time). Observe the MAP sensor data parameter. Observe the MAP sensor display for a skip or jump while increasing the vacuum up to 20" Hg. Did you observe a skip or a jump?	—	Go to *Step 8*	Go to *Step 4*

Step	Action	Value(s)	Yes	No
4	Observe the MAP sensor kPa display with 20" Hg of vacuum applied to the MAP sensor. Is the value less than the value shown?	34 kPa	Go to *Step 5*	Go to *Step 8*
5	Disconnect the hand vacuum pump from the MAP sensor. The MAP sensor display should return to the value recorded in Step 2. Does the MAP sensor display return to the recorded value?	—	Go to *Step 6*	Go to *Step 8*
6	1. Observe and compare the TP sensor data parameter with the throttle at rest to the first specified value. The TP sensor should equal the first value or less. 2. Observe and compare the TP sensor data parameter with the throttle fully open to the second specified value. The TP sensor should equal the second value or greater. Does the TP sensor display indicate the values as expected?	2% to 98%	Go to *Step 7*	Go to *DTC P0121 Throttle Position (TP) Sensor Performance*
7	The fault is not present. Refer to Diagnostic Aids. Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittent Conditions*
8	1. Inspect for proper terminal contact. 2. Inspect the MAP sensor ground circuit for an open or high resistance between the MAP sensor connector and the PCM connector terminal. Was a problem found?	—	Go to *Step 9*	Go to *Step 10*
9	Repair the connections or circuit as necessary. Refer to Wiring Repairs in the GM G Van Service Manual Is the action complete?	—	Go to *Step 11*	—
10	Replace the MAP sensor. Refer to *MAP Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 11*	—
11	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0107 (DTC 34) MAP Sensor Circuit Low Voltage



Circuit Description

The manifold absolute pressure (MAP) sensor is a pressure sensor. The PCM supplies about 5 volts on the MAP sensor reference voltage circuit. The PCM also supplies a ground circuit to the MAP sensor. When manifold vacuum is low the MAP signal voltage rises to near 4.5 volts. As manifold vacuum increases the MAP signal voltage drops to around 1.0 volt. The PCM and the AF ECM monitor MAP signal voltage and determine the vacuum within the intake manifold.
The vehicle also uses the MAP sensor to determine the barometric pressure when the ignition switch is turned ON and the engine is NOT cranked. This BARO reading may also be updated whenever the engine is operated at wide open throttle.
This DTC is used to indicate a MAP sensor signal voltage that is below the normal operating range of the sensor. DTC is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 500 RPM.
- DTCs P0121, P0122 or P0123 are not set.
- VSS less than 5 MPH.

Conditions for Setting the DTC

The AF ECM monitors a MAP sensor signal voltage of less than 0.098 volts for at least 4 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.

- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
5. This step determines if the MAP sensor is the cause of the condition.
6. This step determines if the % volt reference circuit is the cause of the condition (4.8 volts is the minimum output that the PCM should supply to the 5 volt reference circuit).

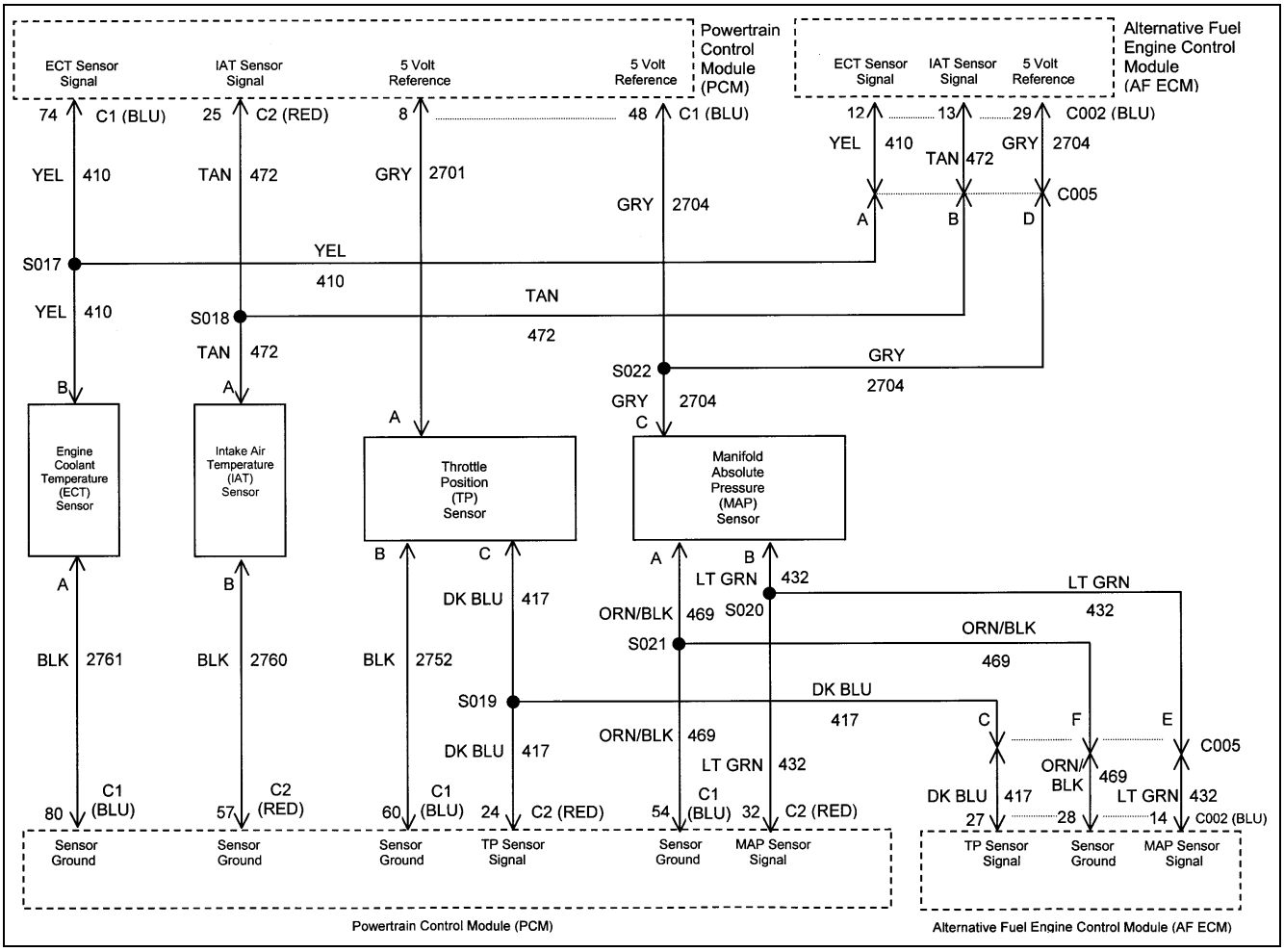
DTC P0107 (DTC 34) MAP Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	**Important!** **The MAP sensor data parameter is only active while the engine is running.** 4. Using the scan tool, establish communication with the PCM. 5. Observe the MAP sensor data parameter. Does the MAP sensor data parameter indicate MAP voltage less than the specified value?	0.20 volts	Go to *Step 5*	Go to *Step 3*
3	4. Using the scan tool, establish communication with the AF ECM. 5. Observe the MAP sensor data parameter. Does the MAP sensor data parameter indicate MAP voltage less than the specified value?	0.09 volts	Go to *Step 13*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Disconnect the MAP sensor connector. 2. Jumper the 5 volt reference circuit terminal to the MAP signal circuit terminal using a 1 amp fused jumper. **Important!** **The PCM MAP sensor data parameter is active only while the engine is running.** 3. With the engine operating, observe the MAP sensor data parameter. Does the MAP sensor data parameter indicate MAP voltage greater than the specified value?	4.8 volts	Go to *Step 11*	Go to *Step 6*
6	1. Remove the jumper. 2. Connect a DVOM between the 5 volt reference circuit terminal and ground. 3. Measure the voltage on the 5 volt reference circuit. Is the voltage less than the specified value?	4.8 volts	Go to *Step 9*	Go to *Step 7*
7	1. Inspect the MAP sensor signal circuit for an open or high resistance between the sensor connector and the PCM. 2. Inspect for proper terminal contact at both the PCM and MAP sensor connector. 3. Repair wiring or terminal contact as necessary. Was a wiring terminal repair necessary?	—	Go to *Step 14*	Go to *Step 8*
8	3. Inspect the MAP sensor signal circuit for a short to engine ground or to the sensor ground circuit. 4. Disconnect the AF ECM connector C002 to determine if the AF ECM is the cause of the short. 5. Repair the wiring as necessary. Was a wiring repair made?	—	Go to *Step 14*	Go to *Step 12*
9	1. Inspect the 5 volt reference circuit for an open or high resistance condition between the MAP sensor connector and the PCM. 2. Inspect for proper terminal contact at the MAP sensor connector and the PCM. 3. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair made?	—	Go to *Step 14*	Go to *Step 10*

Step	Action	Value(s)	Yes	No
10	1. Inspect all 5 volt reference circuits for a short to ground. The 5 volt reference circuits (A and B) are shared with the PCM. The short may be located on either circuit. 2. Disconnect the AF ECM connector that contains the 5 volt reference circuit to determine if the AF ECM is the cause of the short. 3. Disconnect the other sensors that are connected to the PCM 5 volt reference circuit to determine if a sensor is the cause of the short. 4. Repair wiring or replace components as necessary. Was a repair made?	—	Go to *Step 14*	Go to *Step 12*
11	Replace the MAP sensor. Refer to *MAP Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 14*	—
12	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to PCM Replacement in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 14*	—
13	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 14*	—
14	4. Using the scan tool, clear the DTC information from BOTH control modules. 5. Operate the vehicle under the Conditions for Running the DTC. 6. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0108 (DTC 33) MAP Sensor Circuit High Voltage



Circuit Description

The manifold absolute pressure (MAP) sensor is a pressure sensor. The PCM supplies about 5 volts on the MAP sensor reference voltage circuit. The PCM also supplies a ground circuit to the MAP sensor. When manifold vacuum is low the MAP signal voltage rises to near 4.5 volts. As manifold vacuum increases the MAP signal voltage drops to around 1.0 volt. The PCM and the AF ECM monitor MAP signal voltage and determine the vacuum within the intake manifold.

The vehicle also uses the MAP sensor to determine the barometric pressure when the ignition switch is turned ON and the engine is NOT cranked. This BARO reading may also be updated whenever the engine is operated at wide open throttle.

This DTC is used to indicate a MAP sensor signal voltage that is above the normal operating range of the sensor. DTC is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 500 RPM.
- DTCs P0121, P0122 or P0123 are not set.

Conditions for Setting the DTC

The AF ECM monitors a MAP sensor signal voltage of more than 4.8 volts for at least 4 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.

- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.
2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
5. This step determines if the MAP sensor is the shorted condition.
6. This step determines if the open sensor ground condition is present.
7. This step determines if the 5 volt reference circuit is shorted to a voltage (5.2 volts is the maximum output that the PCM should apply to the 5 volt reference circuit).

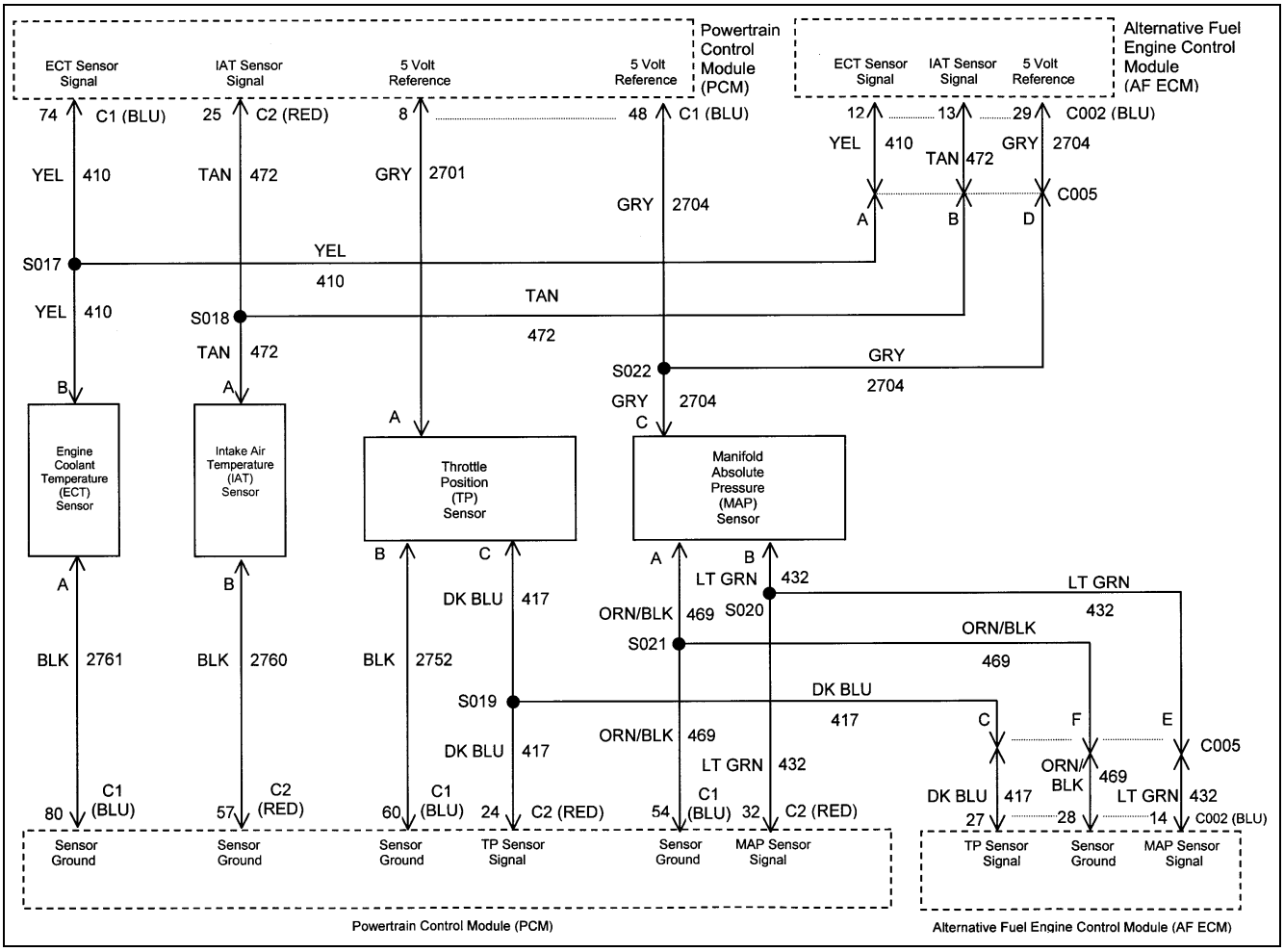
DTC P0108 (DTC 33) MAP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	**Important!** **The MAP sensor data parameter is only active while the engine is running.** 1. Using the scan tool, establish communication with the PCM. 2. Observe the MAP sensor data parameter. Does the MAP sensor data parameter indicate MAP voltage less than the specified value?	4.8 volts	Go to *Step 5*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the MAP sensor data parameter. Does the MAP sensor data parameter indicate MAP voltage greater than the specified value?	4.8 volts	Go to *Step 11*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	1. Disconnect the MAP sensor connector. **Important!** **The PCM MAP sensor data parameter is active only while the engine is running.** Is the MAP voltage less than the specified value?	0.25 volts	Go to *Step 6*	Go to *Step 10*

Step	Action	Value(s)	Yes	No
6	Connect a test light between the sensor ground circuit terminal and battery power. Does the test lamp illuminate?	—	Go to *Step 7*	Go to *Step 9*
7	1. Connect a DVOM between the 5 volt reference circuit terminal and ground. 2. Measure the voltage on the 5 volt reference circuit. Is the voltage less that the specified value?	5.2 volts	Go to *Step 14*	Go to *Step 8*
8	1. Inspect all 5 volt reference circuits for a short to voltage. The 5 volt reference circuits (A and B) are shared with the PCM. The short may be located on either of the 5 volt reference circuits that the PCM provides. 2. Disconnect the AF ECM connector that contains the 5 volt reference circuit to determine if the AF ECM is the cause of the short to voltage. 3. Repair the wiring as necessary. Was a wiring repair made?	—	Go to *Step 17*	Go to *Step 15*
9	1. Inspect the sensor ground circuit for an open or high resistance condition between the MAP sensor connector and the PCM. 2. Inspect for proper terminal contact at the MAP sensor connector and the PCM. 3. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair made?	—	Go to *Step 17*	Go to *Step 15*
10	1. Inspect the MAP signal circuit for a short to voltage. 2. Disconnect the AF ECM connector C002 to determine if the AF ECM is the cause of the short to voltage. 3. Repair the wiring as necessary. Was a wiring repair made?	—	Go to *Step 17*	Go to *Step 15*
11	1. Turn the ignition OFF. 2. Disconnect the AF ECM connector that contains the MAP signal circuit. 3. With the MAP sensor connector disconnected, test the MAP signal circuit for continuity. Is MAP signal circuit continuity indicated?	—	Go to *Step 13*	Go to *Step 12*
12	Repair the open MAP signal circuit between the MAP signal circuit splice and the AF ECM. Is the repair complete?	—	Go to *Step 17*	—

Step	Action	Value(s)	Yes	No
13	1. Inspect for proper terminal contact at the AF ECM connector. 2. Repair terminal contact as necessary. Was a terminal repair made?	—	Go to *Step 17*	Go to *Step 16*
14	Replace the MAP sensor. Refer to *MAP Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 17*	—
15	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 17*	—
16	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 17*	—
17	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0112 (DTC 23) IAT Sensor Circuit Low Voltage



Circuit Description

The IAT sensor is a thermistor. The IAT thermistor has high resistance when cold and low resistance when hot. The PCM supplies about 5 volts on the IAT signal circuit. The PCM also supplies a ground circuit to the IAT sensor. When IAT sensor resistance is high (cold sensor), the IAT signal voltage remains near the supplied 5 volts. As the IAT sensor warms and resistance drops, signal voltage is pulled lower to the sensor ground. The PCM and the AF ECM monitor the IAT signal circuit voltage to determine the temperature of the air entering the engine.

This DTC is used to indicate an IAT signal circuit voltage that is below the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

- The engine has been operating greater than 1.5 minutes.
- The vehicle speed is greater than 1 mph.

Conditions for Setting the DTC

The AF ECM monitors an IAT sensor signal voltage of less than 0.019 volts for at least 5 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.

- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition is present.
5. This step determines of the IAT sensor is shorted.
6. This step determines if a short is present in the wiring harness.
7. This step determines if the PCM or the AF ECM is the cause of the shorted condition.
8. This step determines if an open circuit condition is present between the PCM and the AF connecter C005.

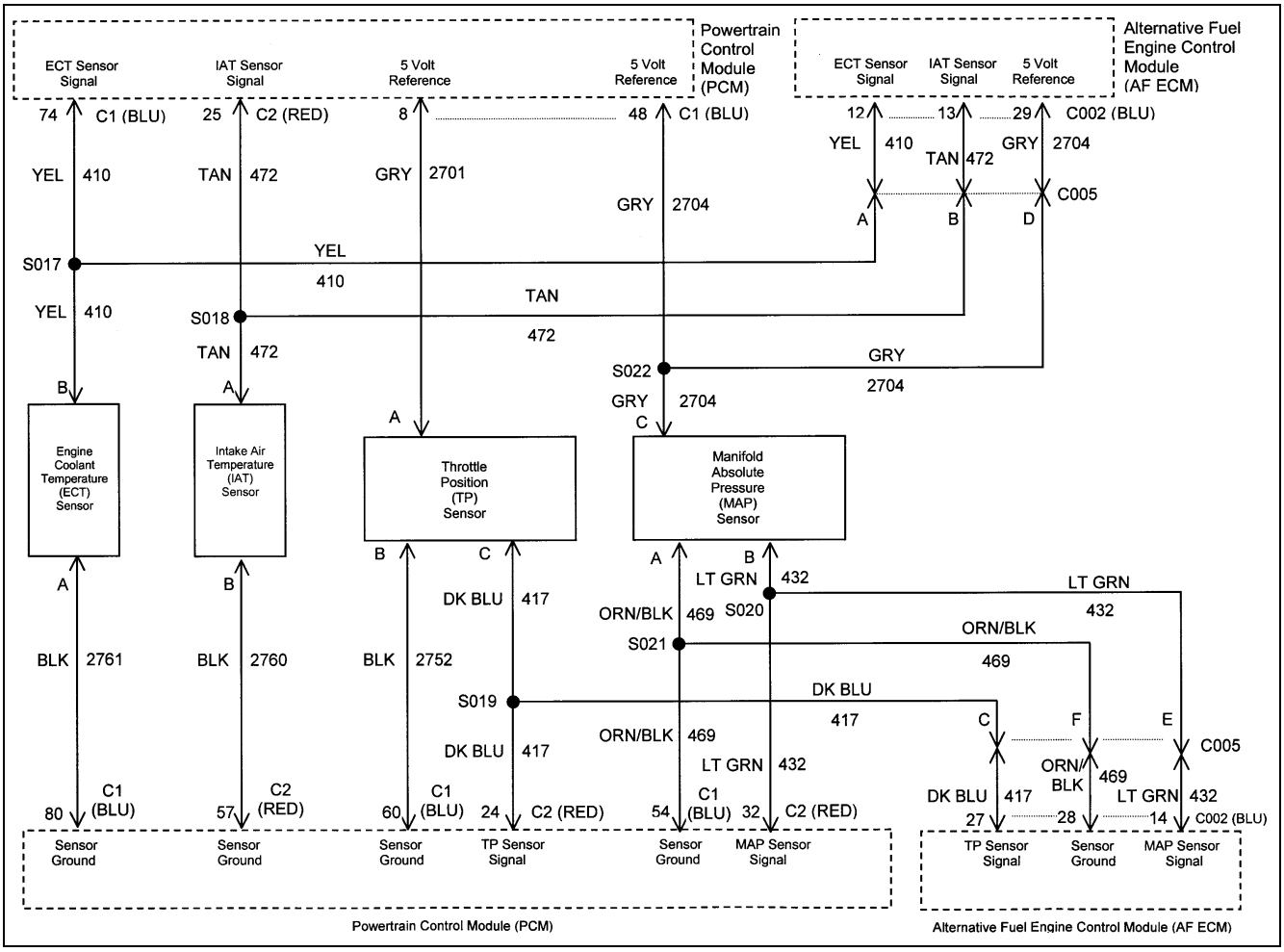
DTC P0112 (DTC 23) IAT Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the IAT sensor data parameter. Does the IAT sensor data parameter indicate IAT voltage less than the specified value?	0.019 volts	Go to *Step 3*	Go to *Step 4*
3	1. Using the scan tool, establish communication with the PCM. 2. Observe the IAT sensor data parameter. Does the IAT sensor data parameter indicate IAT voltage less than the specified value?	0.019 volts	Go to *Step 5*	Go to *Step 8*
4	The fault is not present. Refer to *Diagnostic Aids*. Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	Disconnect the IAT sensor. Does the IAT sensor data parameter indicate IAT voltage less that the specified value?	0.019 volts	Go to *Step 6*	Go to *Step 9*

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the PCM connector that contains the IAT sensor signal circuit. 3. Disconnect the ECM connector that contains the IAT sensor signal circuit. 4. With the IAT sensor connector disconnected, test the IAT sensor signal circuit for continuity to engine ground and to the sensor ground circuit. 5. If a shorted to ground IAT signal circuit is indicated, repair the circuit as necessary. Was an IAT sensor signal circuit repair made?	—	Go to *Step 12*	Go to *Step 7*
7	1. Connect the PCM connector that contains the IAT sensor signal circuit. Leave the AF ECM connector disconnected. 2. Turn the ignition ON with the engine OFF. 3. With the IAT sensor connector disconnected, observe the PCM IAT sensor data parameter. Does the IAT sensor data parameter indicate IAT voltage less that the specified value?	0.019 volts	Go to *Step 10*	Go to *Step 11*
8	1. Inspect the signal circuit between the PCM and 10-way AF connector C005 for the following conditions: • Open circuit • High resistance • Poor terminal contact 2. Repair the wiring or terminals as necessary Was a wiring repair or terminal repair made?	—	Go to *Step 12*	Go to *Step 11*
9	Replace the IAT sensor. Refer to *IAT Sensor Replacement* in Engine Controls in the GM Van service manual. Is the replacement complete?	—	Go to *Step 12*	—
10	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 3. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G VAN service manual. 4. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 12*	—
11	Replace the AF ECM. Refer to *AF ECM Replacement*. Is the replacement complete?	—	Go to *Step 12*	—

Step	Action	Value(s)	Yes	No
12	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0113 (DTC 25) IAT Sensor Circuit High Voltage



Circuit Description

The IAT sensor is a thermistor. The IAT thermistor has high resistance when cold and low resistance when hot. The PCM supplies about 5 volts on the IAT signal circuit. The PCM also supplies a ground circuit to the IAT sensor. When IAT sensor resistance is high (cold sensor), the IAT signal voltage remains near the supplied 5 volts. As the IAT sensor warms and resistance drops, signal voltage is pulled lower to the sensor ground. The PCM and the AF ECM monitor the IAT signal circuit voltage to determine the temperature of the air entering the engine.

The DTC is used to indicate an IAT signal circuit voltage that is above the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

The engine has been operating for greater than 1.5 minutes when the engine start-up temperature is greater than 0°C or (32°F)
OR
The engine has been operating for greater than 10 minutes when the engine start-up temperature is 0°C or (32°F) or less.

- Vehicle speed is less than 1 mph for at least 10 seconds continuously.
- Mass air flow is less than 250 grams per second for at least 10 seconds continuously.

Conditions for Setting the DTC

The AF ECM monitors and IAT sensor voltage greater than 4.9 volts for at least 5 seconds continuously.

Action Taken When the DTC Sets

- The first failure of this DTC will not illuminate the MIL and will store as Last Test Failed but not as history.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drip trips that the DTC runs and passes.
- The history status will clear after FORTY consecutive warm-up cycles with no failures of any DTC.
- All DTC information can be cleared using a scan tool.
- Interruption of AF ECM or PCM power or ground may clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

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Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition affects the gasoline control module.
3. This step determines if the failure condition is present.
5. This step determines if the IAT sensor is the open condition.
6. This step determines if the sensor ground circuit is the open condition.
7. This step determines is the IAT signal circuit wiring is the open condition.
11. If the connector terminals pass inspection test the sensor signal circuit for a short to a 5 volt reference circuit. Although an unlikely failure, this condition should be diagnosed before replacing the PCM.

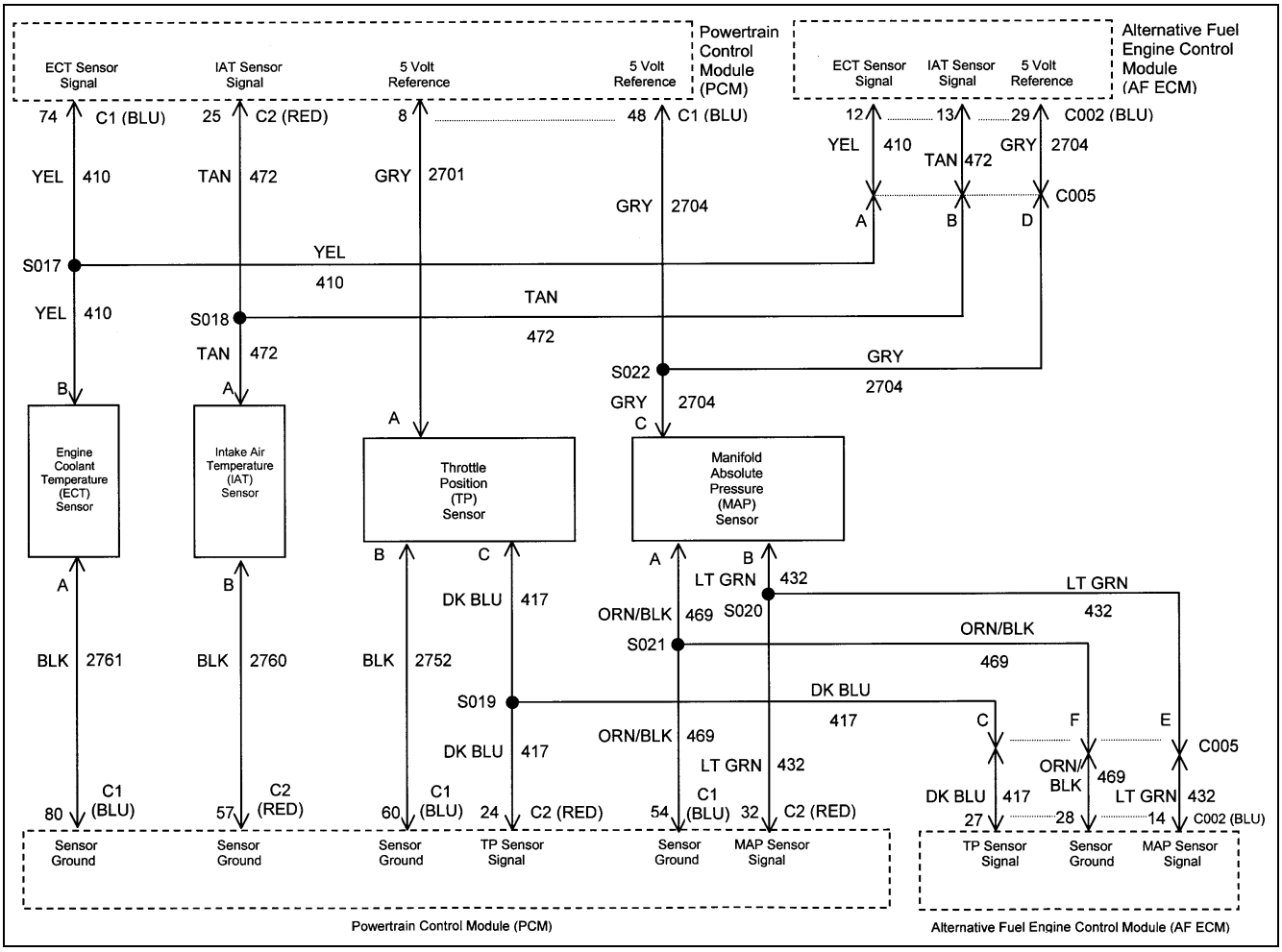
DTC P0113 (DTC 25) IAT Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Using the scan tool, establish communication with the PCM 2. Observe the IAT sensor data parameter. Does the IAT sensor data parameter indicate IAT voltage greater than the specified value?	4.9 volts	Go to *Step 5*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the IAT sensor data parameter. Does the IAT sensor data parameter indicate IAT voltage greater than the specified value?	4.9 volts	Go to *Step 12*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Disconnect the IAT sensor. 2. Connect a fused jumper between the IAT sensor connector terminals. **Note** If the fuse of the jumper opens, repair the short to voltage in the IAT sensor signal circuit. If a short to voltage condition is observed, inspect the sensor for and open condition for an open after the wiring repair is made. Does the IAT sensor data parameter indicate IAT voltage less than the specified value?	0.019 volts	Go to *Step 8*	Go to *Step 6*
6	Connect the fused jumper between the IAT sensor signal circuit and a good known ground. Does the IAT sensor data parameter indicate IAT voltage less than the specified value?	0.019 volts	Go to *Step 9*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector that contains the IAT sensor signal circuit. 3. With the IAT sensor connector disconnected, test the IAT signal circuit for continuity. Is IAT signal circuit continuity indicated?	—	Go to *Step 11*	Go to *Step 10*
8	Replace the IAT sensor. Refer to *IAT Sensor Replacement* in Engine Controls in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 17*	—
9	Repair the open sensor ground circuit between the MAF/IAT sensor connector and the PCM. Is the circuit repair complete?	—	Go to *Step 17*	—
10	Repair the open in the sensor signal circuit between the MAF/IAT sensor connector and the PCM. Is the circuit repair complete?	—	Go to *Step 17*	—
11	1. Inspect for proper terminal contact at the PCM connector. 2. Repair the terminal as necessary. Was a terminal repair made?	—	Go to *Step 17*	Go to *Step 15*
12	1. Turn the ignition OFF. 2. Disconnect the AF ECM connector that contains the IAT sensor signal circuit. 3. With the IAT sensor connector disconnected, test the IAT signal circuit of continuity. Is IAT signal circuit continuity indicated?	—	Go to *Step 13*	Go to *Step 14*

Step	Action	Value(s)	Yes	No
13	1. Inspect for proper terminal contact at the AF ECM connector. 2. Repair the terminal contact as necessary. Was a terminal repair made?	—	Go to *Step 17*	Go to *Step 16*
14	Repair the open IAT sensor signal circuit between the IAT sensor signal circuit splice and the AF ECM. Is the circuit repair complete?	—	Go to *Step 17*	—
15	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G VAN service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 17*	—
16	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 17*	—
17	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0117 (DTC 15) Engine Temperature Sensor (ECT) Sensor Circuit Low Voltage



Circuit Description

The Engine Coolant Temperature (ECT) sensor is a thermistor. The ECT thermistor has high resistance when cold and low resistance when hot. The PCM supplies about 5 volts on the ECT signal circuit. The PCM also supplies a ground circuit to the ECT sensor. When ECT resistance is high (cold sensor) the ECT signal voltage remains near the supplied 5 volts. As the ECT sensor warms and resistance drops, signal voltage is pulled lower to the sensor ground. The PCM and the AF ECM monitor the ECT signal circuit voltage to determine engine temperature.
This DTC is used to indicate an ECT signal voltage that is above the normal operating range of the sensor. This is a type B DTC.

Conditions for Running the DTC

- The engine has been running longer than 5 seconds.

Conditions for Setting the DTC

The AF ECM monitors an ECT sensor signal voltage of less than 0.019 volts for at least 5 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Lest Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.
2. This step determines if the failure condition is present.
5. This step determines if the ECT sensor is shorted.
6. This step determines if a short is present in the wiring harness.
7. This step determines if the PCM or the AF ECM is the cause of the shorted condition.
8. This step determines if an open circuit condition is present between the PCM and AF connector C005.

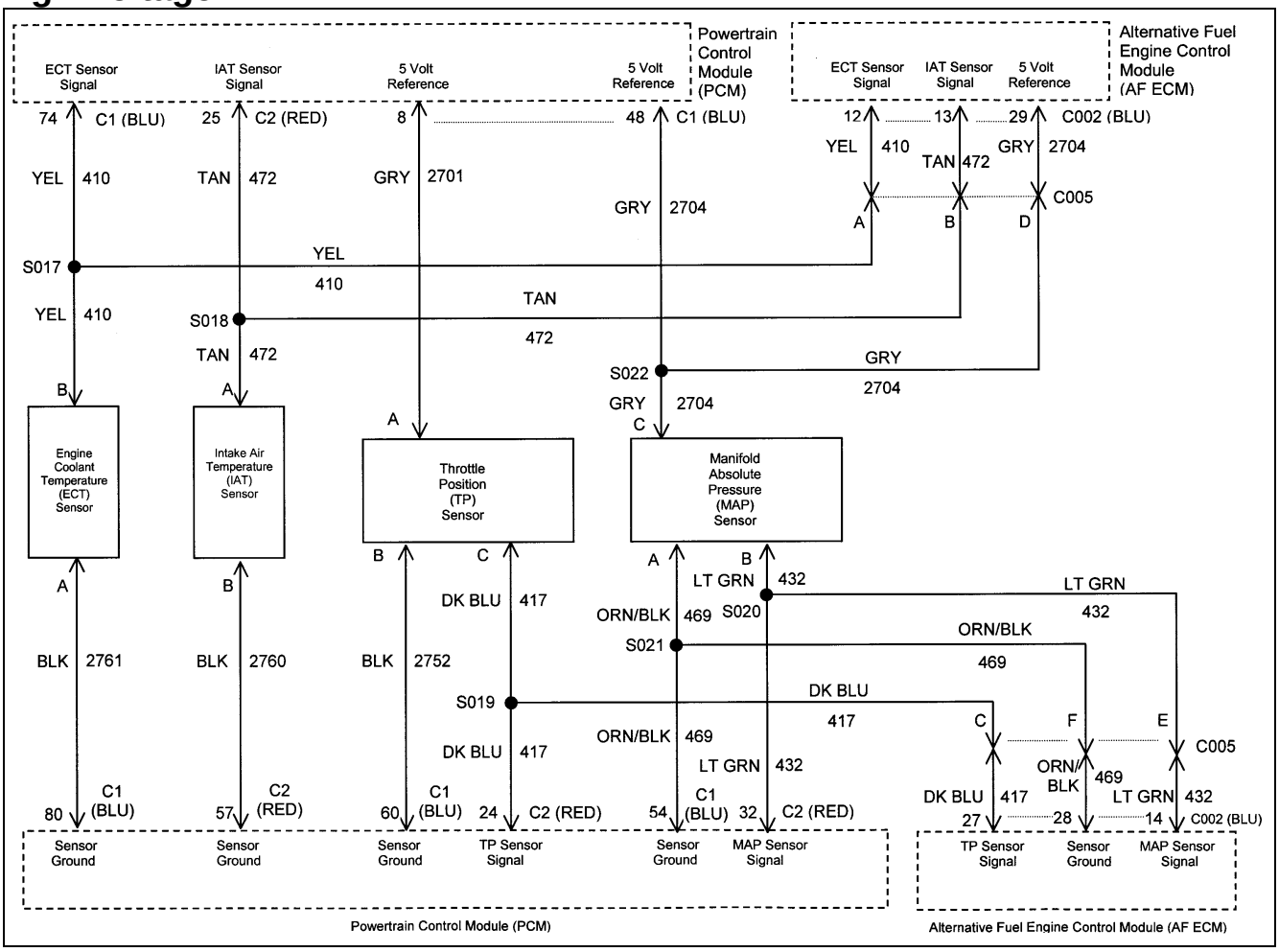
DTC P0117 (DTC 15) ECT Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the ECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 3*	Go to *Step 4*
3	1. Using the scan tool, establish communication with the PCM. 2. Observe the ECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 5*	Go to *Step 8*
4	The fault is not present. Refer to *Diagnostic Aids.* Are DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	Disconnect the ECT sensor. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 6*	Go to *Step 9*

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the PCM connector that contains the ECT signal circuit. 3. Disconnect the AF ECM connector that contains the ECT signal circuit. 4. With the ECT sensor connector disconnected, test the ECT signal circuit for continuity to engine ground and also to the sensor ground circuit. 5. If a shorted to ground ECT signal circuit is found, repair as necessary. Was an ECT signal circuit repair made?	—	Go to *Step 12*	Go to *Step 7*
7	1. Connect the PCM connector that contains the ECT signal circuit. Leave the AF ECM connector disconnected. 2. Turn the ignition ON with the engine OFF. 3. With the ECT sensor connector disconnected, observe the PCMECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 10*	Go to *Step 11*
8	1. Inspect the signal circuit between the PCM connector and the 10-way AF harness connector C005 for the following conditions: • Open circuit • High resistance • Poor terminal contact 2. Repair wiring or terminals as necessary Was a wiring repair or terminal repair made?	—	Go to *Step 12*	Go to *Step 11*
9	Replace the ECT sensor. Refer to *ECT Sensor Replacement* in Engine Controls in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 12*	—
10	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G VAN service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 12*	—
11	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 12*	—

Step	Action	Value(s)	Yes	No
12	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0118 (DTC 14) Engine Coolant Temperature (ECT) Sensor Circuit High Voltage



Circuit Description

The Engine Coolant Temperature (ECT) sensor is a thermistor. The ECT thermistor has high resistance when cold and low resistance when hot. The PCM supplies about 5 volts on the ECT signal circuit. The PCM also supplies a ground circuit to the ECT sensor. When ECT resistance is high (cold sensor) the ECT signal voltage remains near the supplied 5 volts. As the ECT sensor warms and resistance drops, signal voltage is pulled lower to the sensor ground. The PCM and the AF ECM monitor the ECT signal circuit voltage to determine engine temperature.
This DTC is used to indicate an ECT signal voltage that is above the normal operating range of the sensor. This is a type B DTC.

Conditions for Running the DTC

The engine has been operating for greater than 5 seconds when the intake air temperature is greater than 0°C (32°F).
OR
The engine has been operating for greater than 10 minutes when the intake air temperature is less than 0°C (32°F).

Conditions for Setting the DTC

The AF ECM monitors an ECT sensor signal voltage greater that 4.9 volts for at least 5 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Lest Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.

- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.
2. This step determines if the failure condition affects the gasoline control module.
3. This step determines if the failure condition is present.
5. This step determines if the ECT sensor is the open condition.
6. This step determines if the sensor ground circuit is the open condition.
7. This step determines if the ECT signal circuit wiring is the open condition.
11. If the connector terminals pass inspection, test the sensor signal circuit for a short to a 5 volt reference circuit. Although an unlikely failure, this condition should be diagnosed before replacing the PCM.

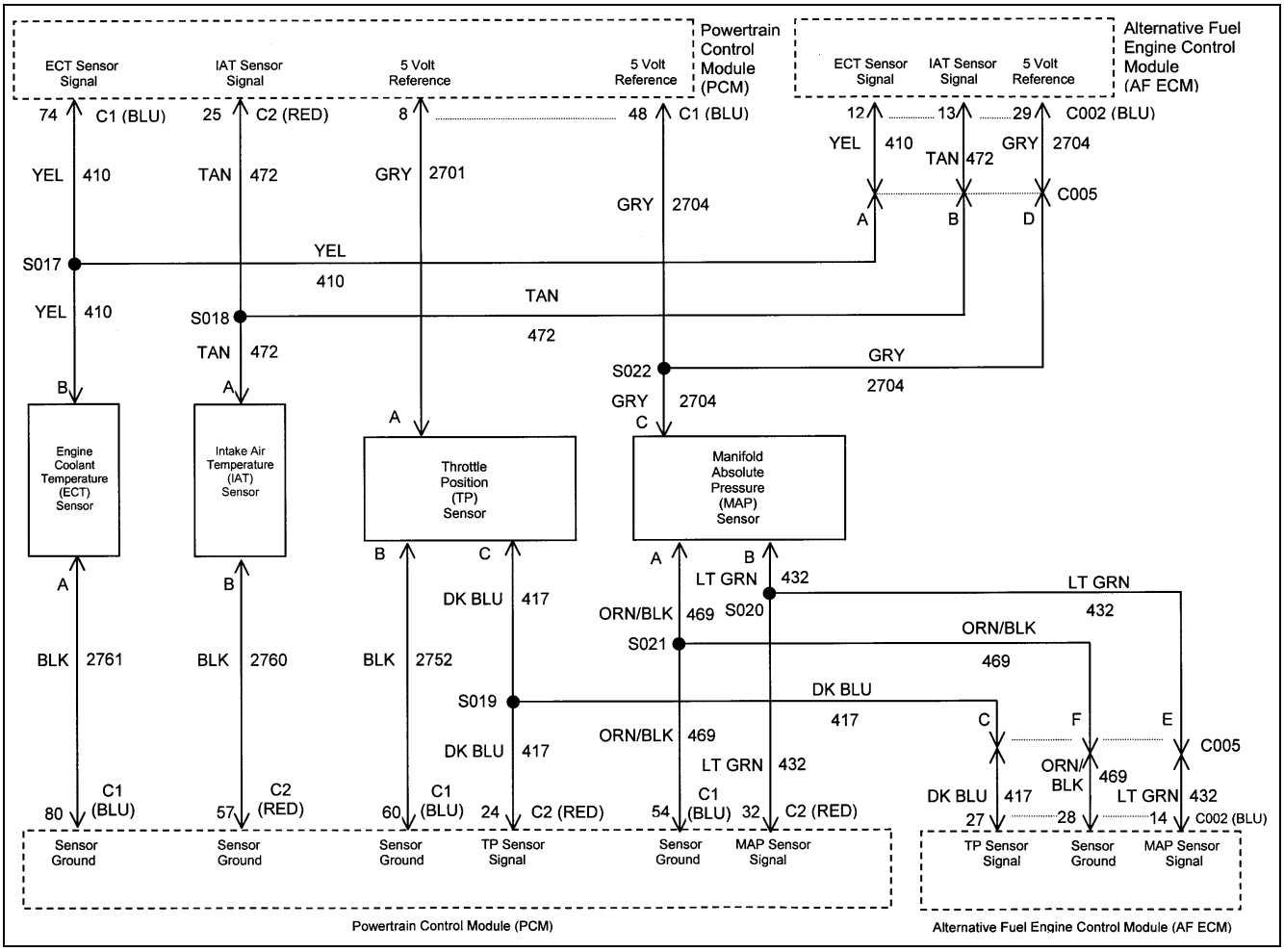
DTC P0118 (DTC 14) ECT Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Using the scan tool, establish communication with the PCM 2. Observe the ECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage greater than the specified value?	4.9 volts	Go to *Step 5*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the ECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage greater than the specified value?	4.9 volts	Go to *Step 12*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Disconnect the ECT sensor. 2. Connect a fused jumper between the ECT sensor connector terminals. **Note** If the fuse of the jumper opens, repair the short to voltage in the ECT sensor signal circuit. If a short to voltage condition is observed, inspect the sensor for and open condition for an open after the wiring repair is made. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 8*	Go to *Step 6*
6	Connect the fused jumper between the ECT sensor signal circuit and a good known ground. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 9*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector that contains the ECT sensor signal circuit. 3. With the ECT sensor connector disconnected, test the ECT signal circuit for continuity. Is ECT signal circuit continuity indicated?	—	Go to *Step 11*	Go to *Step 10*
8	Replace the ECT sensor. Refer to *ECT Sensor Replacement* in Engine Controls in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 17*	—
9	Repair the open sensor ground circuit between the ECT sensor connector and the PCM. Is the circuit repair complete?	—	Go to *Step 17*	—
10	Repair the open ECT signal circuit between the ECT sensor connector and the PCM. Is the circuit repair complete?	—	Go to *Step 17*	—
11	1. Inspect for proper terminal contact at the PCM connector. 2. Repair the terminal as necessary. Was a terminal repair made?	—	Go to *Step 17*	—
12	1. Turn the ignition OFF. 2. Disconnect the AF ECM connector C002. 3. With the ECT sensor connector disconnected, test the ECT signal circuit for continuity. Is ECT signal circuit continuity indicated?	—	Go to *Step 14*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
13	Repair the open ECT sensor signal circuit between the 10-way AF connector C005 and the AF ECM. Is the circuit repair complete?	—	Go to *Step 17*	—
14	1. Inspect for proper terminal contact at the AF ECM connector. 2. Repair the terminal contact as necessary. Was a terminal repair made?	—	Go to *Step 17*	Go to *Step 16*
15	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to PCM Replacement in Engine Controls in the GM G VAN service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 17*	—
16	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 17*	—
17	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0121 (DTC 26) Throttle Position (TP) Sensor Performance



Circuit Description

The throttle position (TP) sensor is a potentiometer. The PCM supplies about 5 volts on the TP sensor reference voltage circuit. The PCM also supplies a ground circuit to the TP sensor. When the throttle is pressed, the TP signal voltage rises to near the supplied 5 volts. As the throttle is released, the TP signal voltage drops to around 0.6 volts. The PCM and the AF ECM monitor the TP signal circuit voltage and determine the angle or opening of the throttle blade.

This DTC is used to indicate a TP signal voltage that is above the normal operating range of the sensor. This is a type B DTC.

Conditions for Running the DTC

- The engine is operating.
- The engine has been operating for greater than 2 seconds.
- No AF ECM DTCs are set.
- The engine MAP is less that 45 kPa.
- The TP sensor angle has changed less than 2% for at least two seconds continuously.

Conditions for Setting the DTC

The TP sensor angle is greater that the specified percentage at the given engine speed.

TP Sensor Angle	Engine Speed
30%	500 RPM
40%	1,500 RPM
50%	2,000 RPM
60%	3,000 RPM
70%	3,500 RPM
80%	4,000 RPM
90%	4,600 RPM

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History after one drive trip in which the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All DTC information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the AF OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5. This step indicates this sensor is currently functioning correctly. If sent to this diagnostic procedure form other service information, return to that procedure now.
6. This step isolates the signal circuit from the other possible causes of the DTC condition.
7. This step determines if the 5 volt reference circuit has the proper voltage. The amperage available on the 5 volt reference circuit should be about 180 mA.
8. This step determines if the signal circuit is shorted to voltage or open.
9. This step determines if the sensor ground circuit has good continuity. With the TP signal circuit jumpered to 5 volts and grounded through the sensor ground circuit terminal, very little voltage should be available at the TP signal circuit.

DTC P0121 (26) TP Sensor Circuit Performance

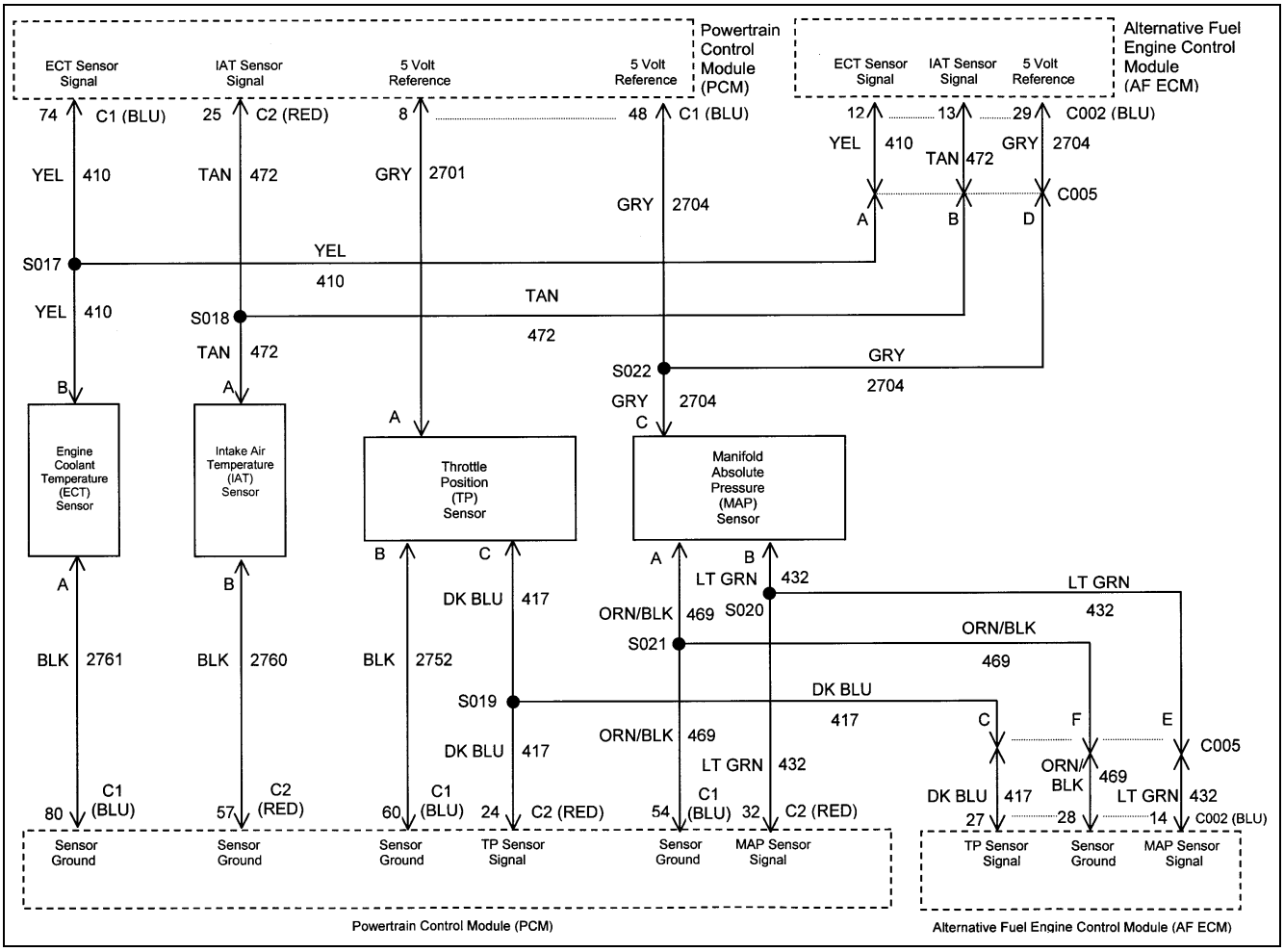
Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Turn the ignition ON with the engine OFF. 2. Using the scan tool, establish communication with the AF ECM. 3. Observe the TP sensor angle data parameter. Does the TP sensor data parameter indicate TP voltage greater than the specified value?	2%	Go to *Step 3*	Go to *Step 6*
3	Depress the throttle slowly to wide open throttle (WOT). Does the scan tool display the throttle angle above the specified value?	98%	Go to *Step 4*	Go to *Step 6*
4	Release the throttle. Does the scan tool display the throttle angle below the specified value?	2%	Go to *Step 5*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
5	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
6	1. Disconnect the TP sensor harness connector. Other DTCs may be set. 2. Connect a fused jumper between the TP signal circuit and the 5 volt reference circuit terminal, 3. Observe the TP sensor voltage data parameter. Does the TP sensor data parameter indicate TP voltage greater than the specified value?	4.9 volts	Go to *Step 7*	Go to *Step 10*
7	1. Remove the fused jumper. 2. Connect the DVOM test leads between the TP sensor 5 volt reference circuit terminal and a known good ground. 3. Measure the voltage on the 5 volt reference circuit. Is the voltage within the specified range?	4.8 – 5.2 volts	Go to *Step 8*	Go to *Step 12*
8	1. Using a fused jumper, connect the TP sensor signal terminal to a known good ENGINE ground. If the jumper fuse opens, repair the signal circuit shorted to battery voltage. Other DTCs may be set. 2. Observe the TP sensor voltage data parameter. Is the voltage less than the specified value?	0.08 volts	Go to *Step 9*	Go to *Step 14*
9	1. Connect a fused jumper between the TP signal circuit terminal and the 5 volt reference circuit terminal. 2. Connect another fused jumper between the TP sensor ground circuit terminal and the 5 volt reference circuit jumper. Other DTCs may be set. 3. Observe the TP sensor voltage data parameter. Does the scan tool display TP sensor voltage less than the specified value?	0.08 volts	Go to *Step 11*	Go to *Step 15*
10	1. Test the TP signal circuit for a short to ground or to the sensor ground circuit. 2. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 19*	Go to *Step 18*
11	1. Test the TP signal circuit for a short to voltage if the jumper fuse opens or a short to the 5 volt reference circuit. 2. Inspect the TP sensor connector for poor terminal contact. 3. Repair wiring or terminals as necessary. Was a wiring or terminal repair made?	—	Go to *Step 19*	Go to *Step 16*

Step	Action	Value(s)	Yes	No
12	1. Turn on the ignition OFF. 2. Disconnect both AF ECM connectors. 3. Turn the ignition ON with the engine OFF. 4. Re-measure the voltage on the 5 volt reference circuit. Is the voltage within the specified range?	4.8 – 5.2 volts	Go to *Step 18*	Go to *Step 13*
13	1. Test the 5 volt reference circuit for a short to voltage – above 5.2, a short to ground or high circuit resistance – below 4.8 volts. 2. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 19*	Go to *Step 17*
14	1. Inspect the TP sensor signal circuit for an open or high resistance condition between the AF ECM connector terminal and the circuit splice. 2. Inspect the AF ECM connect and any in-line connectors, if applicable, for proper terminal contact. 3. Repair wiring or terminals as necessary. Was a repair necessary?	—	Go to *Step 19*	Go to *Step 18*
15	Test the TP sensor ground circuit for high resistance or poor terminal contact at the PCM connector. Repair wiring or terminal contact as necessary. Was a repair made?	—	Go to *Step 19*	Go to *Step 17*
16	Replace the TP sensor. Refer to TP *Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 19*	—
17	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 19*	—
18	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 19*	—

Step	Action	Value(s)	Yes	No
19	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0122 (DTC 22) Throttle Position (TP) Sensor Circuit Low Voltage



Circuit Description

The throttle position (TP) sensor is a potentiometer. The PCM supplies about 5 volts on the TP sensor reference voltage circuit. The PCM also supplies a ground circuit to the TP sensor. When the throttle is pressed, the TP signal voltage rises to near the supplied 5 volts. As the throttle is released, the TP signal voltage drops to around 0.6 volts. The PCM and the AF ECM monitor the TP signal circuit voltage and determine the angle or opening of the throttle blade.

This DTC is used to indicate a TP signal voltage that is below the normal operating range of the sensor. This is a type B DTC.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

The AF ECM monitors a TP sensor signal voltage of less than 0.09 volts for at least 1 second continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Lest Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All DTC information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the AF OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.
2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
4. This step determines if the TP signal is going low only when the throttle is opened.
6. This step determines if the TP sensor is the cause of the condition.
7. This step determines if the 5 volt reference circuit is the cause of the condition. The 4.8 volts is the minimum output that the PCM should supply on the 5 volt reference circuit.

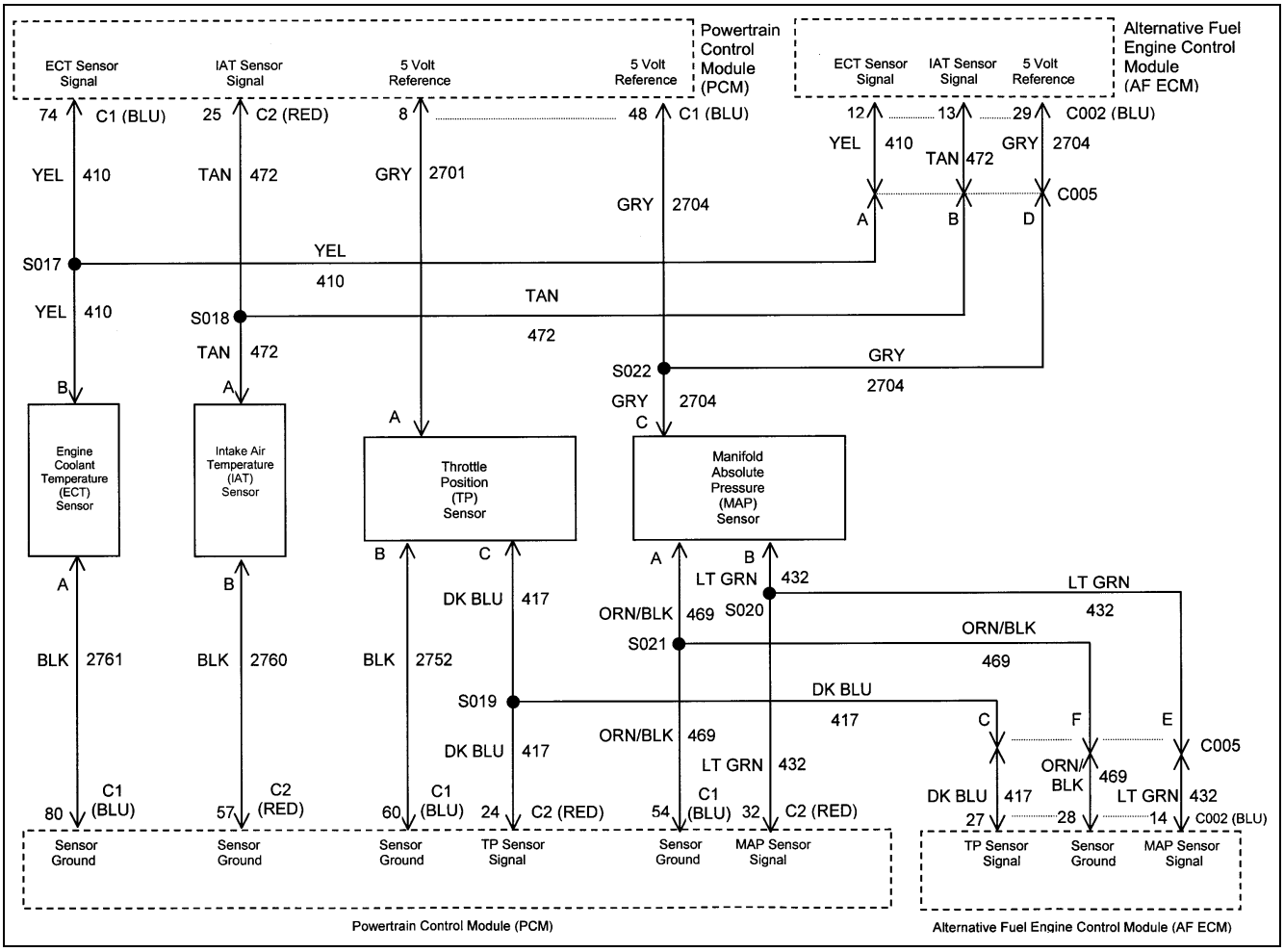
DTC P0122 TP Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Turn the ignition ON with the engine OFF. 2. Using the scan tool, establish communication with the PCM. 3. Observe the TP sensor data parameter. Does the TP sensor data parameter indicate TP voltage less than the specified value?	0.09 volts	Go to *Step 6*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the TP sensor data parameter. Does the TP sensor data parameter indicate TP voltage less than the specified value?	0.09 volts	Go to *Step 14*	Go to *Step 4*
4	Open and close the throttle while observing the TP sensor data parameter. Does the TP sensor data parameter ever indicate TP voltage less than the specified value?	—	Go to *Step 6*	Go to *Step 5*
5	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
6	1. Disconnect the TP sensor connector. 2. Jumper the 5 volt reference circuit terminal to the TP signal circuit terminal using a fused jumper. 3. Observe the TP sensor data parameter. Does the TP sensor data parameter indicate TP voltage greater than the specified value?	4.8 volts	Go to *Step 12*	Go to *Step 7*
7	1. Remove the jumper. 2. Connect a DVOM between the 5 volt reference circuit terminal and ground. 3. Measure the voltage on the 5 volt reference circuit. Is the voltage less than the specified value?	4.8 volts	Go to *Step 10*	Go to *Step 8*
8	1. Inspect the TP sensor signal circuit for an open or high resistance between the sensor connector and the PCM. 2. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 15*	Go to *Step 9*
9	1. Test the TP sensor signal circuit for a short to engine ground or to the sensor ground circuit. 2. Disconnect the AF ECM connector containing the TP sensor signal to determine if the ECM is the cause of the short. 3. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 15*	Go to *Step 13*
10	1. Inspect the 5 volt reference circuit for an open or high resistance condition between the sensor connector and the PCM connector terminal. 2. Inspect for proper terminal contact at both the PCM connector and the TP sensor connector. 3. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair necessary?	—	Go to *Step 15*	Go to *Step 11*
11	1. Inspect all 5 volt reference circuits or a short to ground. Some 5 volt reference circuits are shared with the PCM. The short may be located on either of the 5 volt reference circuits that the PCM provides. 2. Disconnect the AF ECM connector that contains the 5 volt reference circuit to determine if the ECM is the cause of the short. 3. Disconnect the other sensors that are connected to the PCM 5 volt reference circuits to determine if a sensor is the cause of the short. 4. Repair wiring or replace components as necessary. Was a repair made?	—	Go to *Step 15*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
12	Replace the TP sensor. Refer to TP *Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 15*	—
13	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 15*	—
14	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 15*	—
15	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0123 (DTC 21) Throttle Position (TP) Sensor Circuit High Voltage



Circuit Description

The throttle position (TP) sensor is a potentiometer. The PCM supplies about 5 volts on the TP sensor reference voltage circuit. The PCM also supplies a ground circuit to the TP sensor. When the throttle is pressed, the TP signal voltage rises to near the supplied 5 volts. As the throttle is released, the TP signal voltage drops to around 0.6 volts. The PCM and the AF ECM monitor the TP signal circuit voltage and determine the angle or opening of the throttle blade.

This DTC is used to indicate a TP signal voltage that is above the normal operating range of the sensor. This is a type B DTC.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

The AF ECM monitors a TP sensor signal voltage of greater than 4.9 volts for at least 1 second continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Lest Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History after TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All DTC information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the AF OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the failure condition affects the PCM.
3. This step determines if the failure condition is present.
4. This step determines if the TP signal is going high only when the throttle is opened.
6. This step determines if the TP sensor is the cause of the shorted condition.
7. This step determines if an open sensor ground condition is present.
8. This step determines if the 5 volt reference circuit is shorted to voltage. The 5.2 volts is the maximum output that the PCM should supply on the 5 volt reference circuit.

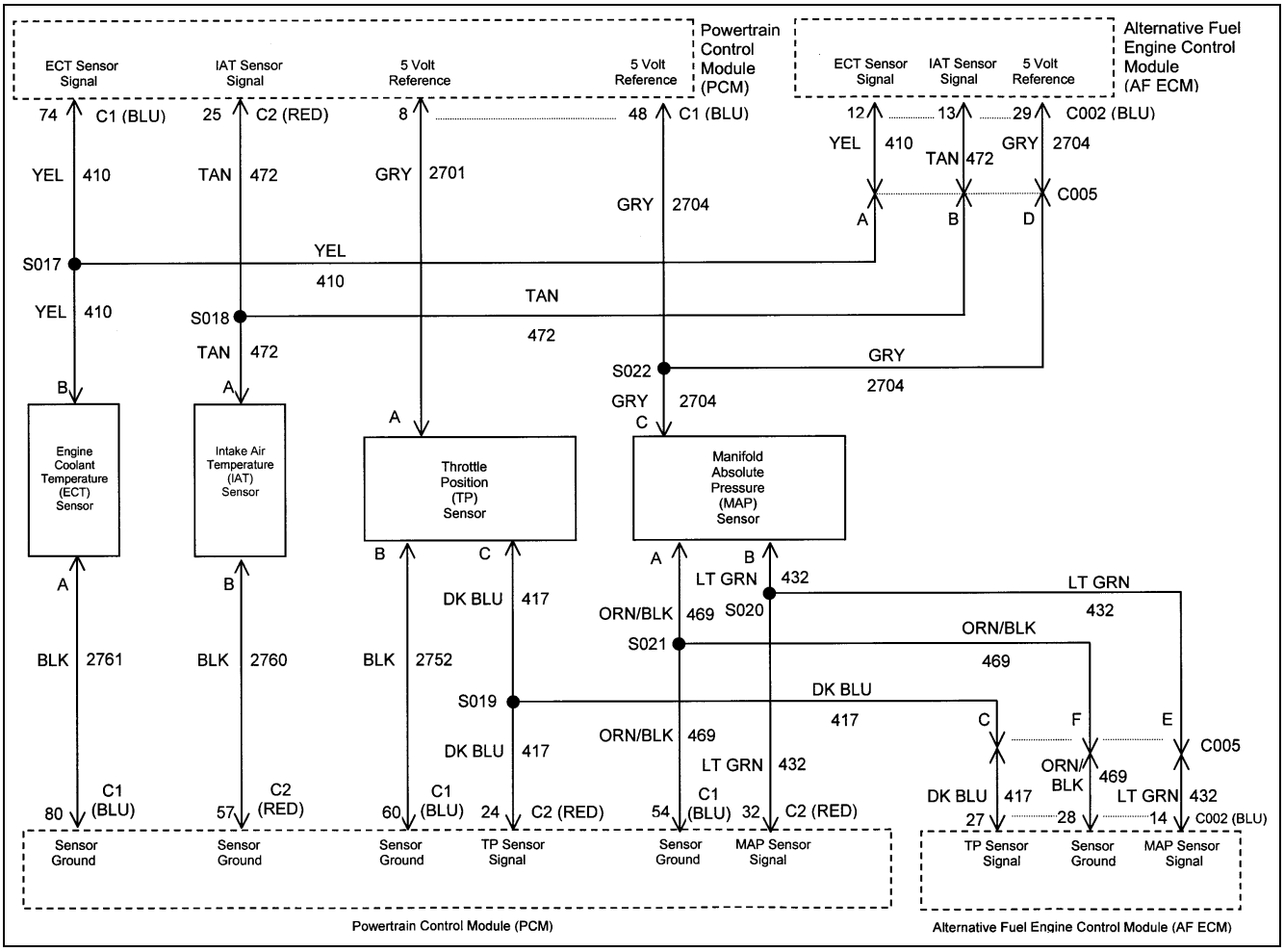
DTC P0123 TP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Turn the ignition ON with the engine OFF. 2. Using the scan tool, establish communication with the PCM. 3. Observe the TP sensor data parameter. 4. Fully depress the accelerator pedal. Does the TP sensor data parameter indicate TP voltage greater than the specified value?	4.9 volts	Go to *Step 6*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Observe the TP sensor data parameter. Does the TP sensor data parameter indicate TP voltage less than the specified value?	4.9 volts	Go to *Step 12*	Go to *Step 4*
4	Open and close the throttle while observing the TP sensor data parameter. Does the TP sensor data parameter ever indicate TP voltage greater than the specified value?	4.9 volts	Go to *Step 6*	Go to *Step 5*

Step	Action	Value(s)	Yes	No
5	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
6	1. Disconnect the TP sensor connector. 2. Observe the TP sensor data parameter. Does the TP sensor data parameter indicate TP voltage greater than the specified value?	0.75 volts	Go to *Step 7*	Go to *Step 11*
7	Connect an unpowered test lamp between the sensor ground circuit terminal and battery positive. Is the test lamp illuminated?	—	Go to *Step 8*	Go to *Step 10*
8	Connect a DVOM between the 5 volt reference circuit terminal and ground. Measure the voltage on the 5 volt reference circuit. Is the voltage less than the specified voltage?	5.2 volts	Go to *Step 15*	Go to *Step 9*
9	1. Inspect all 5 volt reference circuits or a short to voltage. Some 5 volt reference circuits are shared with the PCM. The short may be located on either of the 5 volt reference circuits that the PCM provides. 2. Disconnect the AF ECM connector that contains the 5 volt reference circuit to determine if the ECM is the cause of the short to voltage. 3. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 18*	Go to *Step 16*
10	1. Inspect the sensor ground circuit for an open or high resistance condition between the sensor and the PCM connector terminal. 2. Inspect for proper terminal contact at both the PCM connector and the TP sensor connector. 3. Repair wiring or terminal contact as necessary. Was a wiring or terminal repair necessary?	—	Go to *Step 18*	Go to *Step 16*
11	1. Test the TP signal circuit for a short to voltage. 2. Disconnect the AF ECM connector that contains the TP signal circuit to determine if the ECM is the cause of the short to voltage. 3. Repair wiring as necessary. Was a wiring repair made?	—	Go to *Step 18*	Go to *Step 16*

Step	Action	Value(s)	Yes	No
12	1. Turn on the ignition OFF. 2. Disconnect the AF ECM connector that contains the TP signal circuit. 3. Disconnect the TP sensor connector. 4. Test the TP signal circuit for continuity with a DVOM. Does the DVOM indicate continuity?	—	Go to *Step 14*	Go to *Step 13*
13	Repair the open TP signal circuit between the TP signal circuit splice and the AF ECM. Is the circuit repair complete?	—	Go to *Step 18*	—
14	1. Inspect for proper terminal contact at the AF ECM connector. 2. Repair terminal contact as necessary. Was a terminal repair made?	—	Go to *Step 18*	Go to *Step 17*
15	Replace the TP sensor. Refer to TP *Sensor Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 18*	—
16	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 18*	—
17	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 18*	—
18	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0125 (DTC 16) ECT Excessive Time to Closed Loop



Circuit Description

The Engine Coolant Temperature (ECT) sensor is a thermistor. The ECT thermistor has high resistance when cold and low resistance when hot. The PCM supplies about 5 volts on the ECT signal circuit. The PCM also supplies a ground circuit to the ECT sensor. When ECT resistance is high (cold sensor) the ECT signal voltage remains near the supplied 5 volts. As the ECT sensor warms and resistance drops, signal voltage is pulled lower to the sensor ground. The PCM and the AF ECM monitor the ECT signal circuit voltage to determine engine temperature.
This DTC is used to indicate an engine coolant temperature that is less than the temperature necessary to enable AF ECM closed loop fuel control. This DTC is a type A DTC.

Conditions for Running the DTC

- Engine run time is greater than 500 seconds.
- AF ECM DTCs P0112 (23), P0113 (25), P0117 (15) or P0118 (14) are not set.
- This DTC has not tested this ignition cycle.
- The engine has been operating for greater than 8.5 minutes.
- The vehicle speed is greater than 5 MPH.
- Intake air temperature is greater than 5°F (-15°C).
- The engine coolant temperature at engine start-up is between 1°F (-17°C) and 91°F (33°C).

Conditions for Setting the DTC

The AF ECM monitors an engine coolant temperature that has NOT increased above the start-up temperature by 25°C.

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History after ONE drive trip that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

The most likely cause of this DTC is an improperly operating engine coolant system and thermostat. Refer to *Engine Cooling* in the GM G VAN service manual to verify proper cooling system and thermostat operation.

Fault Not Present

Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. Verify that the engine reaches proper operating temperature in a timely manner before continuing with ECT sensor diagnosis.
3. This step determines if the AF ECM can monitor an open ECT signal circuit (high voltage).
4. This step determines if the AF ECM can monitor a shorted EC signal circuit.
5. This step determines if the ECT sensor is accurately monitoring engine coolant temperature.

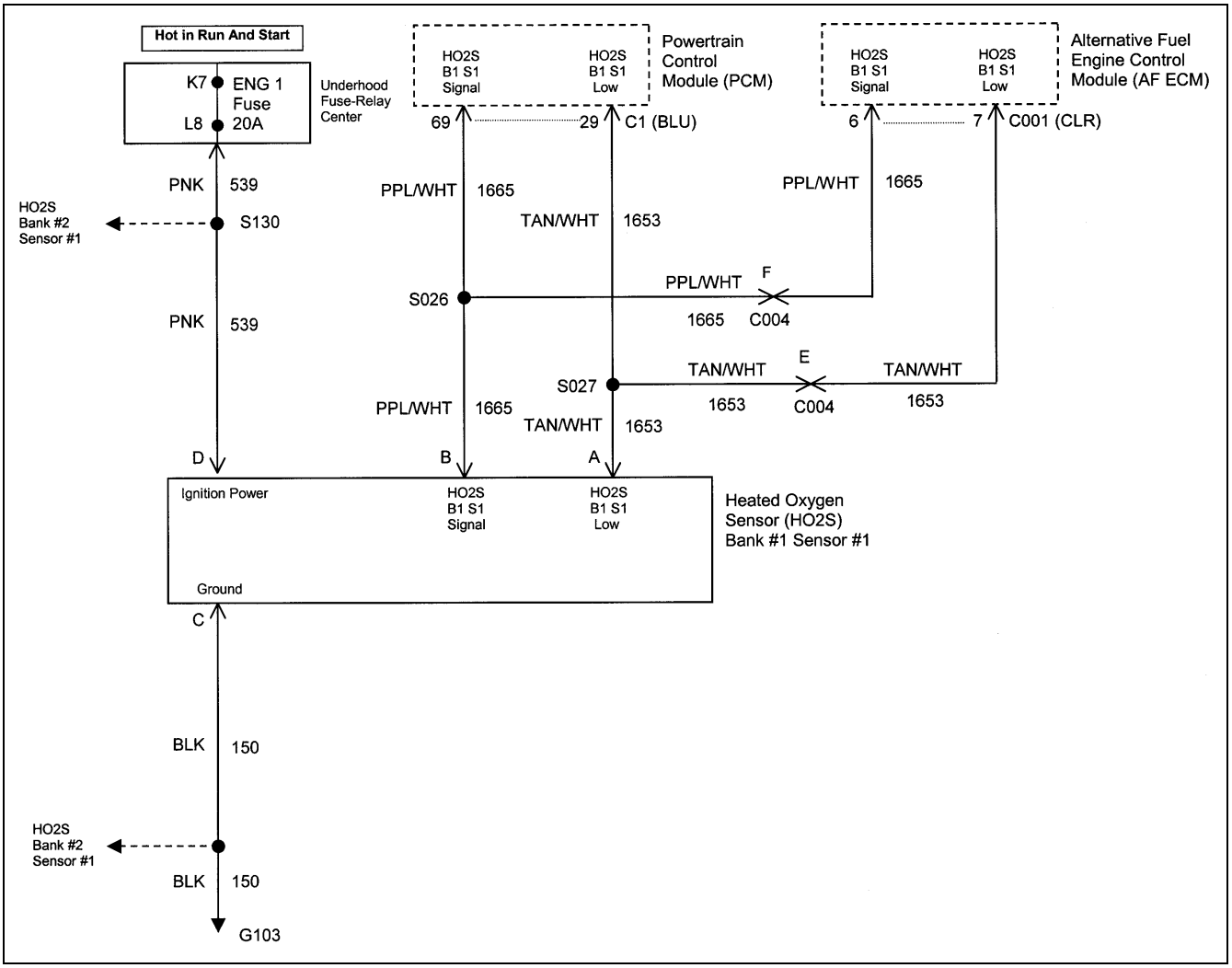
DTC P0125 (DTC 16) ECT Excessive Time to Closed Loop

Step	Action	Value(s)	Yes	No
1	Did you perform Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Verify proper cooling system and thermostat operation. Refer to *Engine Cooling* in the GM G VAN service manual. Is the resistance below the specified value?	—	Go to *Step 11*	Go to *Step 3*
3	1. Using the scan tool, establish communication with the AF ECM. 2. Disconnect the ECT sensor. 3. Observe the ECT sensor data parameter. Does the ECT sensor data parameter indicate ECT voltage greater than the specified value?	4.9 volts	Go to *Step 4*	Go to *Step 7*
4	Connect a 1 amp fused jumper between the ECT sensor connector signal and ground circuit terminals. Does the ECT sensor data parameter indicate ECT voltage less than the specified value?	0.019 volts	Go to *Step 5*	Go to *Step 8*

Step	Action	Value(s)	Yes	No
5	1. Reconnect the ECT sensor connector. **CAUTION** **To avoid being burned, do not remove the radiator cap or surge tank while the engine is hot. The cooling system will release scalding fluid and steam under pressure if the radiator cap or surge tank cap is removed while the engine and radiator are still hot.** 2. Install a thermometer in the engine cooling system to measure actual engine coolant temperature. 3. Start and idle the engine. 4. Allow the engine to operate until the ECT sensor data parameter no longer increases (temperature has stabilized). 5. Observe the ECT sensor data parameter. 6. Measure the actual engine coolant temperature. 7. Compare the ECT sensor data parameter to actual engine coolant temperature. Does the ECT sensor data parameter indicate a temperature near the actual engine coolant temperature?	—	Go to *Step 6*	Go to *Step 9*
6	The fault is not present. Refer to *Diagnostic Aids*. Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
7	1. Inspect the ECT signal circuit for a shorted or low resistance to ground condition. 2. Repair wiring or terminals as necessary. Was a wiring or terminal repair made?	—	Go to *Step 11*	Go to *Step 10*
8	1. Inspect the ECT signal and ground circuits for an open or high resistance condition. 2. Inspect the PCM connector, the AF ECM connector and the ECT sensor connector for proper terminal contact. 3. Repair wiring or terminals as necessary. Was a wiring or terminal repair made?	—	Go to *Step 11*	Go to *Step 10*
9	Replace the ECT sensor. Refer to *ECT Sensor Replacement* in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 11*	—
10	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 11*	—

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool, clear the DTC information from BOTH control modules. 2. Operate the vehicle under the Conditions for Running the DTC. 3. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0131 (DTC 44) HO2S Circuit Low Voltage Bank 1 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV). The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.

This DTC is used to indicate an HO2S signal voltage that is below the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- Engine coolant temperature is greater than 160°F (70°C).
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage of less than 0.08 volts (78 mV) for 15 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 2 Sensor 1 signal. If a Bank 2 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present

Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.
- A heated oxygen sensor pigtail may be mis-routed and contacting the exhaust manifold.
- An intermittent ground in the wire between the connector and the sensor.
- A poor ECM to the engine block ground.
- If the above check out okay, the problem may be a faulty heated sensor.

Never solder the HO2S wires. For proper wire and connector repair, refer to *Wiring Repairs* in Engine Electrical in the appropriate GM G Van Service Manual.

DTC P0131 (DTC 44) HO2S Circuit Low Voltage Bank 1 Sensor 1

Step	Action	Value(s)	Yes	No
1	Was the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Run the engine until normal operating temperature is reached. 2. Using a scan tool, establish communication with the AF ECM. 3. Using a scan tool, monitor the AF ECM HO2S B1 S1 voltage. Is the HO2S voltage fixed less than the value specified?	78 mV	Go to *Step 5*	Go to *Step 3*

Step	Action	Value(s)	Yes	No

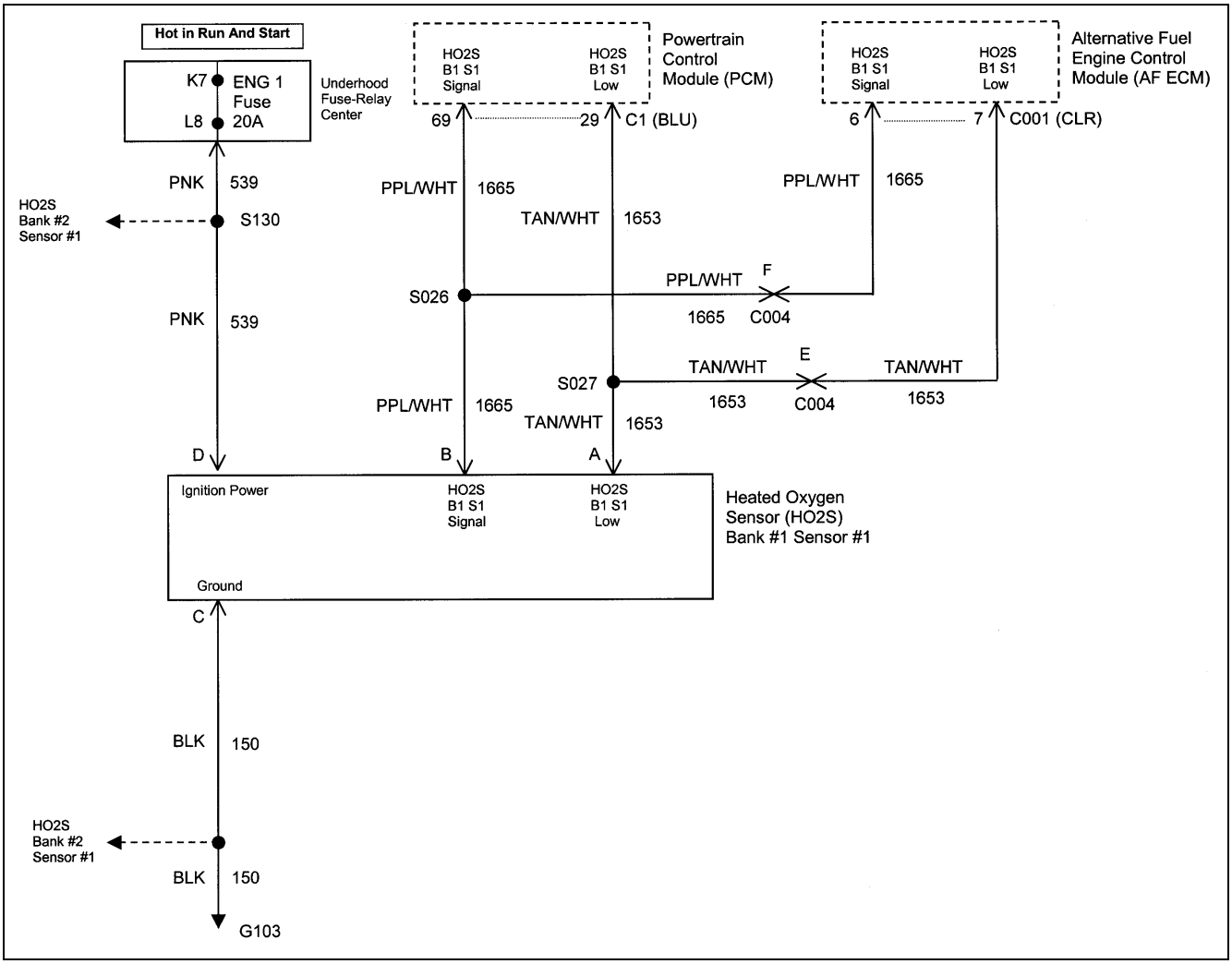
3	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently shorted to engine ground or to the HO2S low circuit.
	• An open between the engine harness circuit splice and the AF ECM connectors.
	• HO2S connector water intrusion.
	• An exhaust leak between the HO2S and the engine.
	• An intermittent lean condition such as the following:
	  • Vacuum leaks
	  • Restricted fuel filter
	  • Low fuel pressure
	  • Lean condition at LPR
	  • Lean condition at fuel mixer
	  • Lean condition at FCS
	  • Lean condition at ICS
	  • An inaccurate MAF sensor
	2. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 16*	Go to *Step 4*

4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	1. Run the engine until normal operating temperature is reached. 2. Using the scan tool, establish communication with the PCM. 3. Using a scan tool, monitor the HO2S B1 S1 voltage. Is the HO2S voltage fixed less that the value specified?	78 mV	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition OFF. 2. Disconnect the AF ECM connectors. 3. Install a ground jumper wire to the underhood LPL at connector C008, Pin B. Refer to *Engine Control Schematics.* 4. Run the engine until normal operating temperature is reached. 5. Using a scan tool monitor the HO2S B1 S1 voltage. Is the HO2S voltage fixed less than the value specified?	78 mV	Go to *Step 7*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Disconnect the HO2S B1 S1 connector. 3. Leave the AF ECM disconnected. 4. Jumper the HO2S low circuit terminal (engine harness side) to a known good ground. 5. Turn the ignition ON while leaving the engine OFF. 6. Using a scan tool monitor the HO2S B1 S1 voltage. Is the HO2S voltage within the value range specified?	351 to 551 mV	Go to *Step 8*	Go to *Step 9*
8	1. The HO2S may be detecting a lean exhaust condition. Inspect for one of the following conditions: • HO2S connector water intrusion • Exhaust leak between the HO2S and the engine. • Vacuum leaks • An inaccurate MAF sensor 2. Repair any of the above or similar engine conditions as necessary. Was a condition found and repair?	—	Go to *Step 16*	Go to *Step 14*
9	1. Turn the ignition OFF. 2. Remove the jumper form the HO2S low circuit terminal. 3. Disconnect the PCM connector that contains the HO2S B1 S1 high signal circuit. 4. Using a DVOM, measure and record the resistance between the HO2S high signal circuit and ground. 5. Using a DVOM, measure and record the resistance between the HO2S high signal circuit and the HO2S low circuit. Is infinite resistance measured on both tests?	—	Go to *Step 15*	Go to *Step 10*
10	Repair the HO2S signal circuit high circuit shorted to ground or shorted to the HO2S low circuit. Is the action complete?	—	Go to *Step 16*	—
11	1. Test the HO2S high and low circuits for continuity between the engine harness circuit splices and the AF ECM connector terminals. 2. Measure for continuity between the oxygen sensor connector and the AF ECM connector. 3. Test for proper terminal contact at the AF ECM connector terminals and at the 10-way LPG harness to engine harness connector terminals. 4. Repair wiring or terminals as necessary. Was a wiring or terminal repair made?	—	Go to *Step 16*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
12	The HO2S may be detecting a lean exhaust. Perform the *AF Fuel System Diagnosis* and return to this step. Was a lean AF fuel system condition found and repaired?	—	Go to *Step 16*	Go to *Step 13*
13	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 16*	—
14	Replace the HO2S. Refer to *HO2S Replacement* in Engine Controls in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 16*	—
15	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G VAN service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 16*	—
16	1. Reconnect all disconnected or removed components, connectors, LPL test jumper, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0132 (DTC 45) HO2S Circuit High Voltage Bank 1 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV). The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.

This DTC is used to indicate an HO2S signal voltage that is above the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- Engine coolant temperature is greater than 160°F (70°C).
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage of greater than 1.0 volt (1000 mV) for 5 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 2 Sensor 1 signal. If a Bank 2 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Always diagnose **ANY** PCM codes that are present before beginning this diagnostic procedure.

Check the following items:

- Fuel pressure - The ECM can compensate for small increases in fuel pressure. However, large increases in fuel pressure may set a DTC.
- Faulty Fuel Control Solenoid (FCS).
- Vacuum leaks in the fuel control valve hoses.
- False rich indication due to silicon contamination of the HO2S. This will be accompanied by lean driveability conditions and a powdery white deposit on the sensor.
- Faulty HO2S (Bank 1 Sensor 1). If the HO2S (Bank 1 Sensor 1) is internally shorted, the HO2S (Bank 1 Sensor 1) voltage displayed will be over 1V. Try disconnecting the HO2S (Bank 1 Sensor 1); if the displayed voltage goes from over 1000 mV to around 450 mV, replace HO2S (Bank 1 Sensor 1).
- Never solder the HO2S wires.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

3. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.
8. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.

DTC P0132 (DTC 45) HO2S Circuit High Voltage Bank 1 Sensor 1

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Run the engine until normal operating temperature is reached. 2. Using a scan tool, establish communication with the AF ECM. 3. Using a scan tool, monitor the AF ECM HO2S B1 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 5*	Go to *Step 3*

3	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently shorted to voltage.
	• A silicon contaminated HO2S.
	• An intermittent rich condition such as the following:
	  • Incorrect fuel pressure
	  • Low coolant level / cooling system not bled at LPR
	  • Leaking low pressure regulator (LPR)
	  • Rich condition at fuel mixer
	  • Rich condition at FCS
	  • Rich condition at ICS
	  • An inaccurate MAF sensor
	2. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 15*	Go to *Step 4*

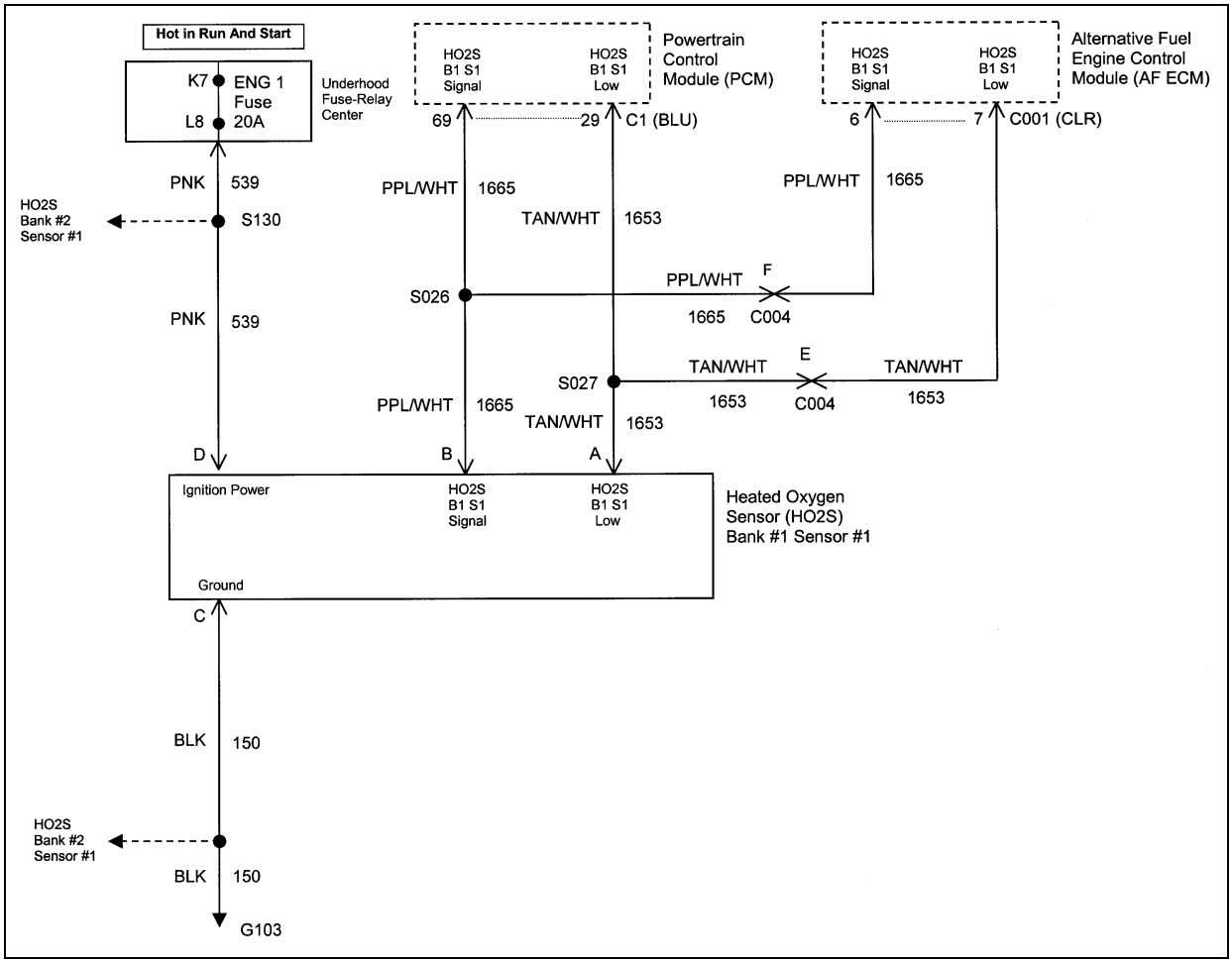
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	1. Run the engine until normal operating temperature is reached. 2. Using the scan tool, establish communication with the PCM. 3. Using a scan tool, monitor the HO2S B1 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 6*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the AF ECM connectors. 3. Install a ground jumper wire to the underhood LPL at connector C008, Pin B. Refer to *Engine Control Schematics.* 4. Run the engine until normal operating temperature is reached. 5. Using a scan tool, monitor the HO2S B1 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 7*	Go to *Step 11*
7	1. Turn the ignition OFF. 2. Disconnect the HO2S B1 S1 connector. 3. Leave the AF ECM disconnected. 4. Jumper the HO2S low circuit terminal (engine harness side) to a known good ground. 5. Turn the ignition ON while leaving the engine OFF. 6. Using a scan tool monitor the HO2S B1 S1 voltage. Is the HO2S voltage within the value range specified?	351 to 551 mV	Go to *Step 8*	Go to *Step 9*
8	1. The HO2S may be detecting a rich exhaust condition. Inspect for one of the following conditions: • HO2S connector water intrusion • Silicone contaminated HO2S • Fuel contaminated engine oil • Incorrect fuel pressure • Low coolant level / cooling system not bled at LPR • Leaking low pressure regulator (LPR) • Rich condition at fuel mixer • Rich condition at FCS • Rich condition at ICS • An inaccurate MAF sensor 2. Repair any of the above or similar engine conditions as necessary. Was a condition found and repair?	—	Go to *Step 15*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
9	1. Turn the ignition OFF. 2. Remove the jumper from the HO2S low circuit terminal. 3. Disconnect the PCM connector that contains the HO2S B1 S1 high signal circuit. 4. Turn the ignition ON leaving the engine OFF. 5. Using a DVOM, measure and record the voltage between the HO2S high signal circuit and ground. Is the voltage measured greater than the value specified?	20 mV	Go to *Step 10*	Go to *Step 14*
10	Repair the HO2S signal circuit high circuit shorted to voltage. Is the action complete?	—	Go to *Step 15*	—
11	The HO2S may be detecting a rich exhaust condition. Perform the *AF Fuel System Diagnosis* and return to this step. Was a rich AF fuel system condition found and repaired?	—	Go to *Step 15*	Go to *Step 12*
12	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 15*	—
13	Replace the HO2S. Refer to *HO2S Replacement* in Engine Controls in the GM G VAN service manual. Is the replacement complete?	—	Go to *Step 15*	—
14	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G VAN service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 15*	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all disconnected or removed components, connectors, LPL test jumper, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

P0134 (DTC 42) HO2S Insufficient Activity Bank 1 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.
This DTC is used to indicate an HO2S signal voltage that is below the normal operating range of the sensor.
During normal closed loop operation, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust. The AF ECM will remove fuel (lean the mixture) when the HO2S indicates a rich exhaust. This oscillation above and below the bias voltage (sometimes referred to as activity or switching) can be monitored with the HO2S signal voltage.
The oxygen sensor contains a heater. The heater quickly warms the sensor to operating temperature. The heater will also maintain operating sensor temperature during extended idle conditions.
This DTC is used to indicate an HO2S with in-active signal voltage.
This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- The engine has been operating for at least 1 minute.
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage stuck between 0.300 V and 0.600 V (in-active) for 8 seconds continuously
OR
The AF ECM monitors an HO2S signal voltage between 0.00 V and 1.0 V that has not performed a rich / lean switch for 8 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 2 Sensor 1 signal. If a Bank 2 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks
Check the following conditions:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.
- A poor connection or a damaged harness
- Backed out terminals
- Improperly formed or damaged terminals
- Poor terminal to wire connection
- Damaged harness
- A poor ECM to the engine block ground.
- Faulty Idle Control Solenoid (ICS) or ICS circuit.
- Faulty Fuel Control Solenoid (FCS) or FCS circuit.
- Faulty fuel mixer.
- Faulty Low Pressure Regulator (LPR).
- Exhaust leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum or crankcase leaks can cause a lean condition or possibly a high idle.
- If the above check out okay, the problem may be a faulty heated sensor.
- A faulty HO2S (Bank 1, Sensor 1) heater or heater circuit. With the ignition switch on but the engine off, the HO2S (Bank 1, Sensor 1) voltage displayed on a scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly.
  If not, disconnect the HO2S (Bank 1, Sensor 1) and connect a test lamp between the terminals *"C" and "D"*. If the test lamp does not light, repair the open in the HO2S (Bank 1, Sensor 1) ground circuit or the HO2S (Bank 1, Sensor 1) ignition feed circuit. If the test lamp lights, replace the HO2S (Bank 1, Sensor 1).
- The intermittent test - With a scan tool, monitor the HO2S (Bank 1, sensor 1) signal voltage while moving the related connectors and the wiring harness with a warm engine running at part throttle in closed loop. If the failure is induced, the HO2S (Bank 1, Sensor 1) signal voltage reading changes from its normal fluctuating voltage (above 600 mV and below 300 mV) to a fixed value around 450 mV. This may help isolate the location of the malfunction.
- Never solder the HO2S wires. For proper wire and connector repair, refer to Wiring Repairs in Engine Electrical.

Test Description

The number(s) below refer to the step numbers on the diagnostic table.

2. This step determines if proper sensor activity us present. When in closed loop fuel control, the HO2S voltage should rapidly swing above the bias voltage.

6. This step determines if the PCM and the high and low circuits between the PCM and HO2S connector are operating properly.
9. This step determines if the HO2S heater circuit operates correctly up to the HO2S connector.
10. This step determines if the proper circuit resistance exists between the HO2S low circuit and the PCM ground.
15. This step determines if the proper circuit resistance exists between the HO2S low circuit and the PCM ground with a cold sensor. A loose HO2S or poor cold thread to exhaust electrical contact will cause higher resistance when the HO2S is cold. Although 500 ohms is allowed, typical resistance should be less than 50 ohms.

DTC P0134 (DTC 42) HO2S Insufficient Activity Bank 1 Sensor 1

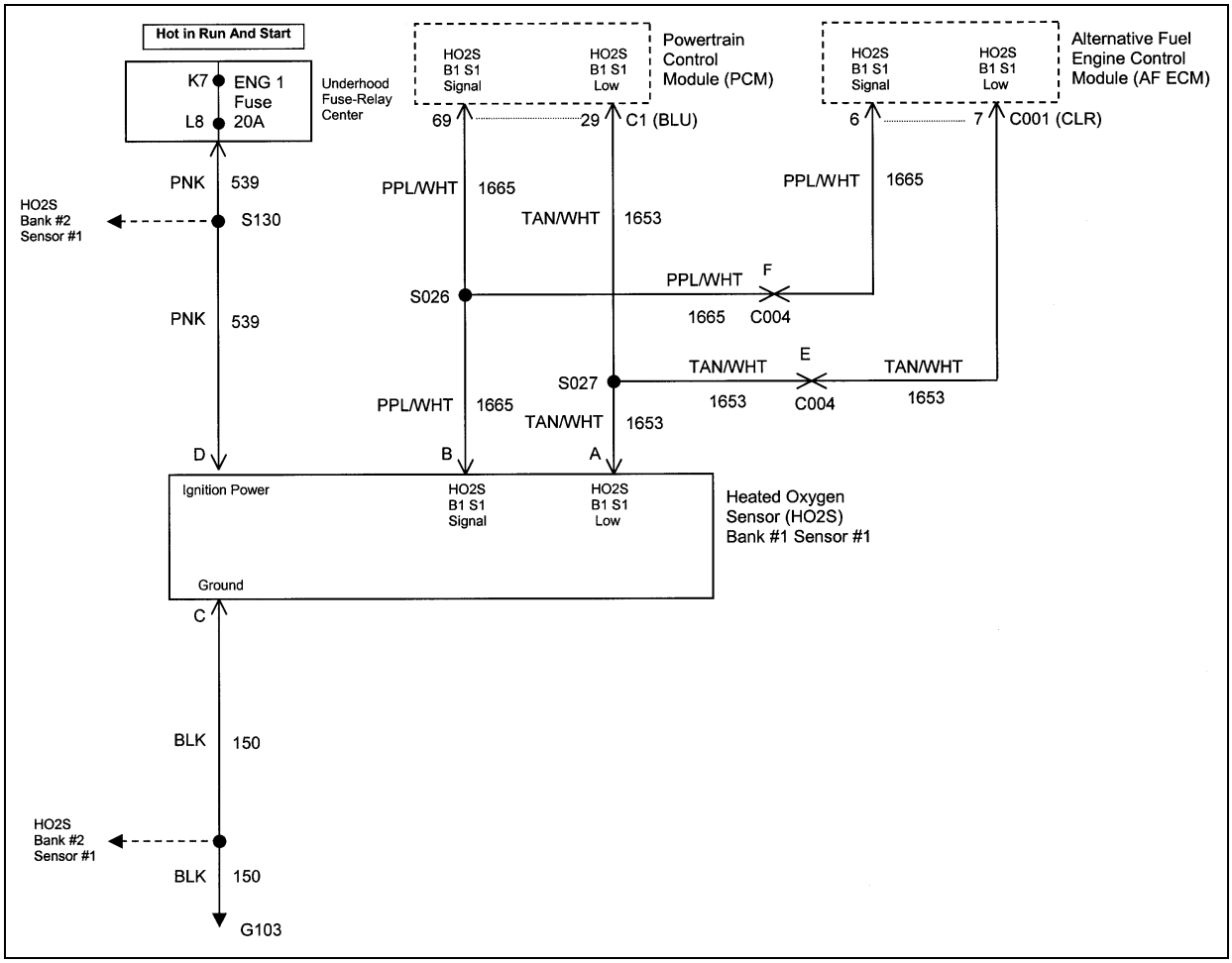
Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Use a scan tool to establish communication with the AF ECM. 2. Capture the DTC information from the AF ECM in the scan tool. 3. Clear the DTC information using the scan tool. 4. Reset the fuel trim values. 5. Start and idle the engine until normal operating temperature is reached. 6. Use the scan tool to monitor the HO2S B1 S1 voltage. Is the voltage fixed within the specified range?	0.1 to 1.0 volts	Go to *Step 5*	Go to *Step 3*
3	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions: • Water intrusion of the HO2S connector. • An intermittently open HO2S high signal circuit • An intermittently open HO2S low circuit • An HO2S low circuit with high resistance to ground • Any AF ECM ground circuits with high resistance to ground • An inoperative HO2S heater • A faulty HO2S or PCM terminal contact • An exhaust system leak (typically within 12 inches upstream of the HO2S). • A defective HO2S 2. Repair any of the above conditions as necessary. Was a condition found and repaired?	—	Go to *Step 22*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Use a scan tool to establish communication with the AF ECM. 2. Start and idle the engine until normal operating temperature is reached. 3. Use the scan tool to monitor the HO2S B1 S1 voltage. Is the voltage fixed within the specified range?	0.10 to 1.0 volts	Go to *Step 6*	Go to *Step 17*
6	1. Turn the ignition OFF. 2. Disconnect the HO2S B1 S1 electrical connector. 3. Jumper the HO2S low circuit to a known good ground. 4. Jumper the HO2S high signal circuit to a know good ground. 5. Turn the ignition ON leaving the engine OFF. 6. Use the scan tool to monitor the HO2S B1 S1 voltage. Is the voltage less than the specified value?	20 mV	Go to *Step 9*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Remove the jumpers from the HO2S terminals. 3. Disconnect the PCM connector containing the HO2S high and low circuits. 4. Use a DVOM to measure continuity of the HO2S high signal circuit and HO2S low signal circuit between the PCM connector and the HO2S connector terminal (engine harness side). Are both resistances less than the specified value?	5 ohms	Go to *Step 8*	Go to *Step 11*
8	1. Inspect for proper PCM connector terminal contact. 2. Repair the terminals as necessary Was a terminal repair made?	—	Go to *Step 22*	Go to *Step 21*
9	1. Remove the jumpers from the HO2S terminals. 2. Connect a test lamp between the HO2S heater ignition feed and heater ground circuit terminals (engine harness side). 3. Turn the ignition ON leaving the engine OFF. Does the test lamp illuminate?	—	Go to *Step 10*	Go to *Step 12*
10	1. Turn the ignition OFF. 2. Reconnect the HO2S connector. 3. Disconnect the PCM connector containing the HO2S low circuit and the PCM connector containing the PCM ground circuits. 4. Using a DVOM, measure the resistance between the HO2S low circuit terminal and one of the PCM grounds. Is the resistance less than the specified value?	500 ohms	Go to *Step 14*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
11	Repair the circuit that measured high resistance. Did you complete the repair?	—	Go to *Step 17*	—
12	Repair the HO2S heater ignition or ground circuit. Possible causes include the following: • An open circuit • A high circuit resistance • A faulty ground connection • A blown heater fuse (other DTCs may be set) Did you complete the repair?	—	Go to *Step 22*	—
13	Repair the high resistance between the HO2S low circuit and the PCM ground circuit. Possible causes include the following: • A faulty HO2S connector terminal contact • An open sensor harness low circuit (requires HO2S replacement) • A sensor harness low circuit with high resistance (requires HO2S replacement) • A faulty PCM ground connection • A high PCM ground circuit resistance • An ungrounded exhaust system Did you complete the repair?	—	Go to *Step 22*	—
14	1. Inspect for exhaust system leaks upstream of the suspect HO2S. The leak may be very small and is typically within 12 inches of the HO2S. 2. Repair the exhaust as necessary. Was an exhaust system repair made?	—	Go to *Step 22*	Go to *Step 15*
15	1. Allow the engine to cool to ambient temperature. 2. Using a DVOM, re-measure the resistance between the HO2S low circuit terminal and a PCM ground circuit terminal. Is the resistance less than the specified value?	500 ohms	Go to *Step 19*	Go to *Step 16*
16	1. Remove the HO2S from the exhaust. 2. Clean the HO2S mounting threads. 3. Apply HO2S safe anti-seize compound to the sensor threads. 4. Tighten the HO2S to the proper torque. Refer to *HO2S Replacement* in the GM G Van service manual. 5. Using a DVOM, measure the resistance between the HO2S low circuit terminal and a PCM ground circuit terminal. Is the resistance less than the specified value?	500 ohms	Go to *Step 22*	Go to *Step 20*

Step	Action	Value(s)	Yes	No
17	1. Inspect the oxygen sensor signal and low circuit for continuity between the AF ECM connector terminals and the oxygen sensor connector terminal. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, PCM and the AF ECM connectors are disconnected before testing the circuits. 3. Repair the wiring as necessary. Was a wire repair made?	—	Go to *Step 22*	Go to *Step 18*
18	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 22*	—
19	Perform the AF Fuel System diagnosis and return to this step. Refer to *AF Fuel System Diagnosis*? Was an LPG fuel system problem found and repaired?	—	Go to *Step 22*	Go to *Step 20*
20	Replace the HO2S. Refer to *HO2S Replacement* in the GM G Van service manual. Did you complete the repair?	—	Go to *Step 22*	—
21	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 22*	—
22	1. Reconnect all disconnected or removed components, connectors, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0135 (DTC 43) HO2S Heater Performance Bank 1 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV. The AF ECM monitors the bias voltage as well as the voltage produced by the HO2S.

During normal closed loop fuel control, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust content. When the HO2S indicates a rich exhaust content, the AF ECM will add fuel (lean the mixture). This oscillation above and below the bias voltage (sometimes referred to as activity or switching) can be monitored with the HO2S signal voltage.

The oxygen sensor contains a heater. The heater is used to quickly warm the sensor to operating temperature. The heater will also maintain operating sensor temperature during extended idle conditions. A functions oxygen sensor heater will allow the sensor to produce voltage in less time. A sensor at operating temperature will cause the HO2S signal voltage to go above or below (depending upon exhaust oxygen content) the bias voltage.

This DTC is used to indicate an HO2S signal voltage that did not leave the cold sensor bias voltage range in an acceptable amount of time. This DTC is a type B DTC.

Conditions for Running the DTC

- AF ECM DTCs P0117 (15), P0118 (14), P0125 (16), P0131 (44), P0132 (45). P0134 (42) are not set.
- The start-up engine coolant temperature is less than 91°F (33°C).

- The engine has been operating for at least five seconds.
- The average mass air flow is less than 35 grams per second.
- All other AF ECM DTCs for this HO2S sensor have ran and passed.
- This DTC has not tested this ignition cycle.
- The AF ECM determines the HO2S was cold at ignition key ON. The average HO2S signal voltage must be within the bias voltage range of 0.30 volts (300 mV) to 0.60 volts (600 mV) for the AF ECM to determine the HO2S was cold.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage that did not leave the cold sensor bias voltage range of 0.30 volts (300 mV) to 0.060 volts (600 mV) in an acceptable amount of time. The time varies from 50 seconds to 110 seconds based upon mass air flow.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Check for the following condition:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. As the heater warms the oxygen sensor to operating temperature, the HO2S will output a voltage in relation to the amount of oxygen in the exhaust. With the ignition ON and the engine OFF, the exhaust usually contains a high oxygen content. With the engine OFF, the HO2S voltage will usually decrease from the initial (bias) voltage due to the high oxygen content.
6. This step test for proper HO2S heater ignition power and ground supply.
7. This step tests for proper PCM and signal circuit operation.

DTC P0135 (DTC 43) HO2S Heater Performance Bank 1 Sensor 1

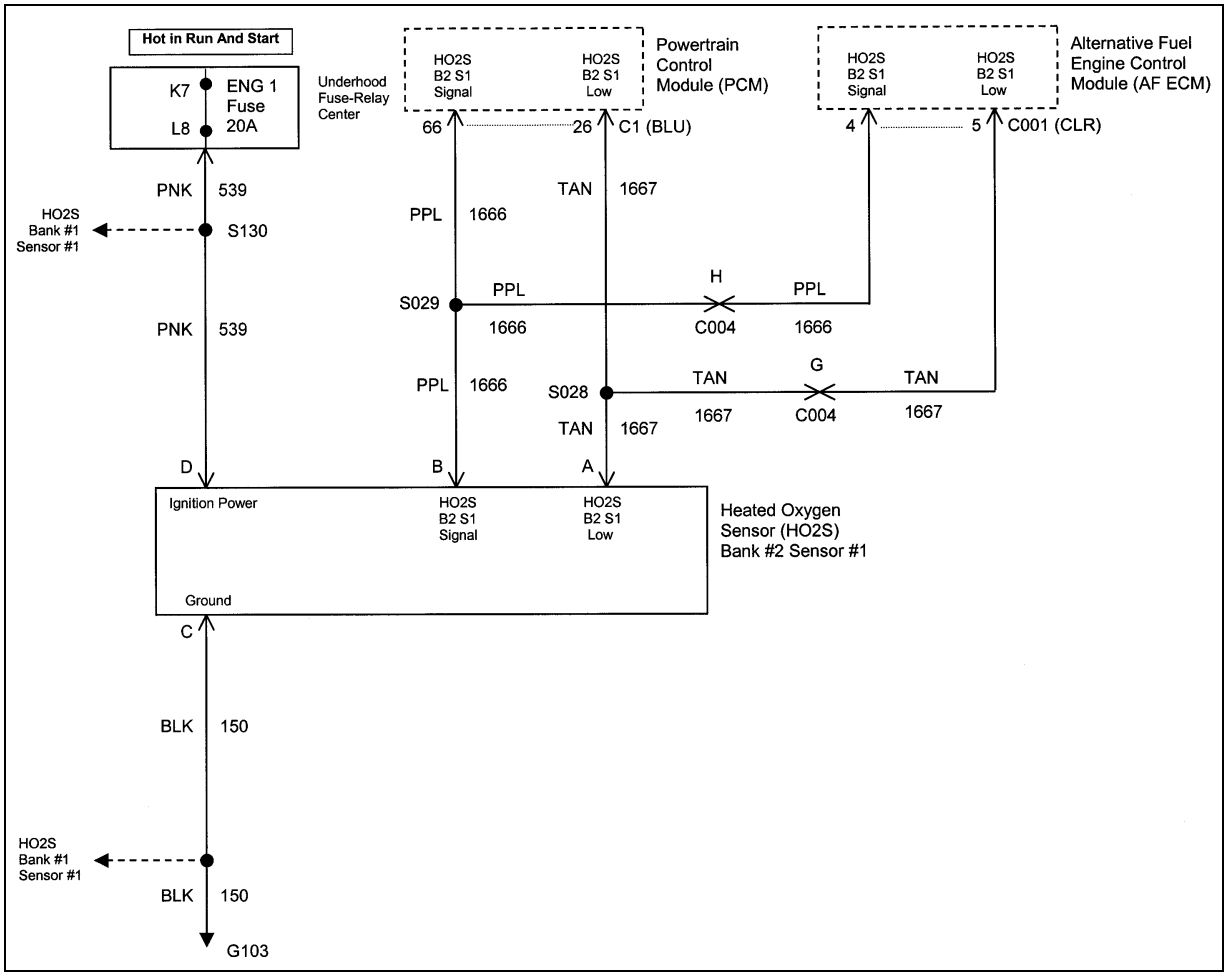
Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*

Step	Action	Value(s)	Yes	No
2	**Important:** The HO2S must be cool before proceeding with this diagnosis. The ignition must remain OFF for at least on half hour before proceeding with the diagnosis. 1. Connect a scan tool. 2. Set-up the scan tool with the proper vehicle identification prior to turning the ignition ON. Establish communication with the PCM. 3. Turn the ignition ON, leaving the engine OFF, and as quickly as possible observe and record the HO2S voltage for the sensor that applies to this DTC. 4. Observe the HO2S voltage for two minutes. Does the HO2S voltage increase or decrease from the initial voltage by at least the specified value?	150 mV	Go to *Step 3*	Go to *Step 6*
3	1. Allow the HO2S voltage to stabilize. 2. Use the scan tool to observe and record the current HO2S voltage from the PCM. 3. Use the scan tool to establish communication with the AF ECM. 4. Use the scan tool to observe and record the current voltage from the AF ECM for the HO2S B1 S1. Does the AF ECM indicate the same HO2S voltage as the PCM, plus or minus the specified value?	45 mV	Go to *Step 4*	Go to *Step 14*
4	The condition that set this DTC is not present. This DTC may have been set by one of the following conditions: • An intermittently open or high resistance HO2S high signal circuit or low circuit. • An intermittently open or high resistance HO2S heater feed or ground circuit. • A faulty HO2S or gasoline PCM terminal contact. • A defective HO2S. • Repair any of the above conditions as necessary. Was a condition found and repaired?	—	Go to *Step 18*	Go to *Step 5*
5	The fault is not present. Refer to *Diagnostic Aids*. Are any DTCs stored that have not been diagnosed?	—	Go to AF *DTC List*	Go to *Intermittents*
6	1. Turn the ignition OFF. 2. Disconnect the HO2S B1 S1 connector. 3. Connect an un-powered test lamp between the HO2S heater ignition feed and ground circuit terminals (engine harness side). 4. Turn the ignition ON leaving the engine OFF. Does the test lamp illuminate?	—	Go to *Step 7*	Go to *Step 8*

Step	Action	Value(s)	Yes	No
7	1. Disconnect the test lamp. 2. Jumper the HO2S low circuit terminal to a known good ground. 3. Jumper the HO2S high circuit terminal to a known good ground. 4. Use the scan tool to monitor the HO2S B1 S1 voltage. Ensure the ignition is ON while the engine is OFF. Is the voltage less than the specified range?	20 mV	Go to *Step 10*	Go to *Step 9*
8	Connect the test lamp between the HO2S heater ignition feed circuit terminal (engine harness side) and a known good ground. Ensure the ignition is ON while the engine is OFF. Does the test lamp illuminate?	—	Go to *Step 11*	Go to *Step 12*
9	1. Turn the ignition OFF. 2. Remove the jumpers from the HO2S terminals. 3. Disconnect the PCM connector containing the HO2S high and low circuits. 4. Using a DVOM, measure the continuity of the HO2S high signal circuit and the HO2S low signal circuit between the PCM and the HO2S connector terminal (engine harness side). Are both resistances less than the specified value?	5 ohms	Go to *Step 16*	Go to *Step 13*
10	Replace the HO2S sensor. Refer to *Heated Oxygen Sensor (HO2S) Replacement* in the GM G Van service manual. Is the action complete?	—	Go to *Step 18*	—
11	Repair the open HO2S heater ground circuit Is the action complete?	—	Go to *Step 18*	—
12	1. Repair the lack of power on the HO2S heater ignition feed circuit. 2. If the fuse is open, repair the short to ground on the circuit. An open fuse or lack of power to the fuse may cause other DTCs or symptoms to be present. Is the action complete?	—	Go to *Step 18*	—
13	Repair the circuit that measured high resistance. Is the action complete?	—	Go to *Step 18*	—

Step	Action	Value(s)	Yes	No
14	1. Inspect the HO2S sensor signal and low circuit for continuity between the AF ECM connector terminals and the HO2S connector terminals. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, gasoline control module and the AF ECM connectors are disconnected before testing circuits. 3. Repair the wiring as necessary. Was a problem found?	—	Go to *Step 18*	Go to *Step 15*
15	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 18*	—
16	1. Inspect for proper PCM terminal contact. 2. Repair the terminals as necessary. Was a problem found and repaired?	—	Go to *Step 18*	Go to *Step 17*
17	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 3. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 4. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 18*	—
18	**Important!** The HO2S must be cool before proceeding with this diagnosis. The ignition must remain OFF for at least one half hour before proceeding with diagnosis. 1. Connect a scan tool. 2. Set-up the scan tool with the proper vehicle identification information prior to turning the ignition ON. 3. Turn the ignition ON, leaving the engine OFF, and as quickly as possible observe and record the HO2S voltage for the sensor that applies to this DTC. 4. Observe the HO2S voltage for 2 minutes. Does the voltage increase or decrease from the initial voltage by at least the specified value?	150 mV	System OK	Go to *Step 2*

DTC P0151 (DTC 64) HO2S Circuit Low Voltage Bank 2 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV). The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.

This DTC is used to indicate an HO2S signal voltage that is below the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- Engine coolant temperature is greater than 160°F (70°C).
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage of less than 0.08 volts (78 mV) for 15 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 1 Sensor 1 signal. If a Bank 1 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Check for the following condition:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.

Fault Not Present

Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks

- A heated oxygen sensor wire: A sensor pigtail may be mis-routed and contacting the exhaust manifold.
- An intermittent ground in the wire between the connector and the sensor.
- A poor ECM to the engine block ground.
- If the above check out okay, the problem may be a faulty heated sensor.

Never solder the HO2S wires. For proper wire and connector repair, refer to *Wiring Repairs* in Engine Electrical in the appropriate GM G Van Service Manual.

DTC P0151 (DTC 64) HO2S Circuit Low Voltage Bank 2 Sensor 1

Step	Action	Value(s)	Yes	No
1	Was the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	4. Run the engine until normal operating temperature is reached. 5. Using a scan tool, establish communication with the AF ECM. 6. Using a scan tool, monitor the AF ECM HO2S B2 S1 voltage. Is the HO2S voltage fixed less than the value specified?	78 mV	Go to *Step 5*	Go to *Step 3*

Step	Action	Value(s)	Yes	No

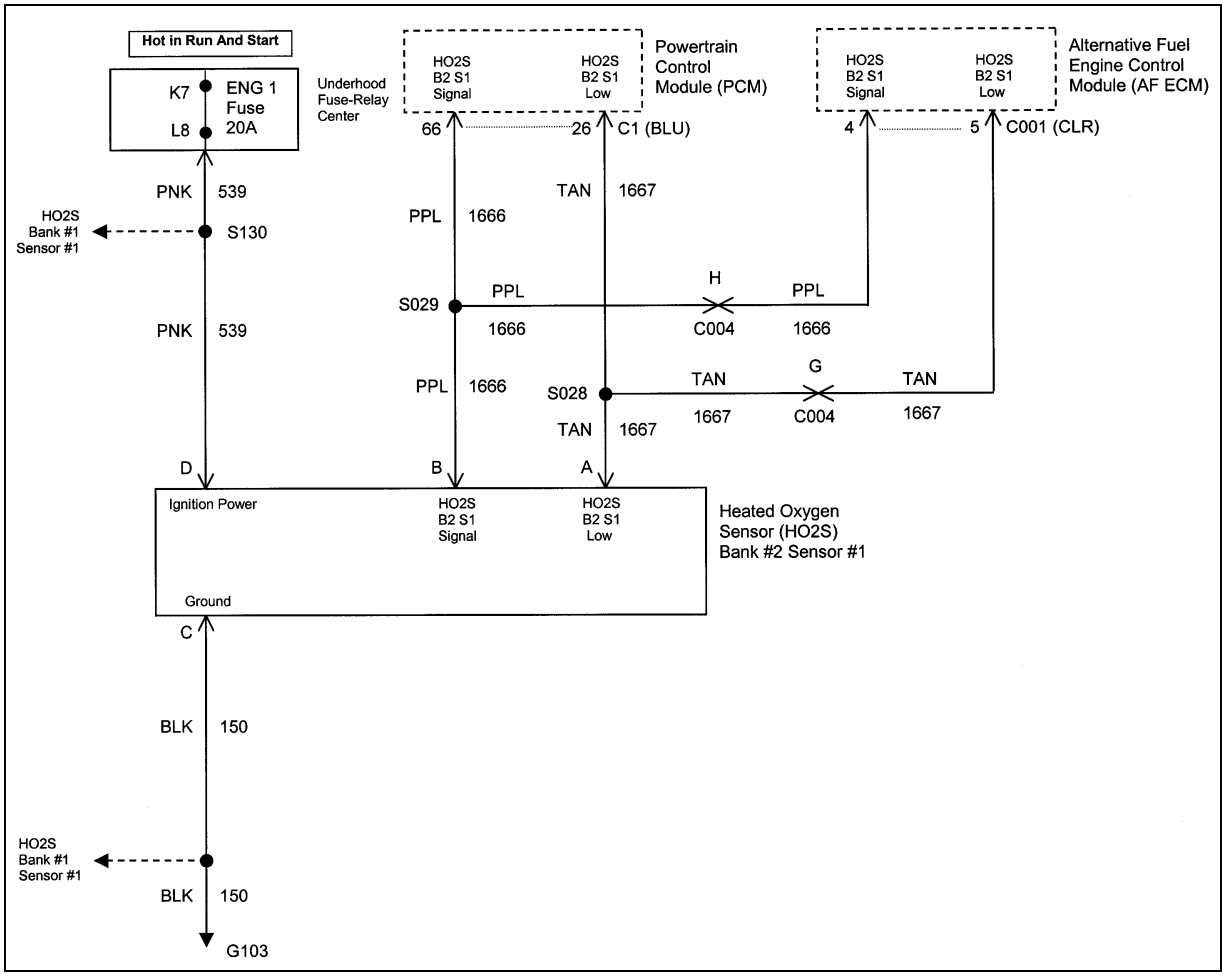
3	2. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently shorted to engine ground or to the HO2S low circuit.
	• An open between the engine harness circuit splice and the AF ECM connectors.
	• HO2S connector water intrusion.
	• An exhaust leak between the HO2S and the engine.
	• An intermittent lean condition such as the following:
	  • Vacuum leaks
	  • Restricted fuel filter
	  • Low fuel pressure
	  • Lean condition at LPR
	  • Lean condition at fuel mixer
	  • Lean condition at FCS
	  • Lean condition at ICS
	  • An inaccurate MAF sensor
	3. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 16*	Go to *Step 4*

4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	4. Run the engine until normal operating temperature is reached. 5. Using the scan tool, establish communication with the PCM. 6. Using a scan tool, monitor the HO2S B2 S1 voltage. Is the HO2S voltage fixed less that the value specified?	78 mV	Go to *Step 6*	Go to *Step 11*
6	6. Turn the ignition OFF. 7. Disconnect the AF ECM connectors. 8. Install a ground jumper wire to the underhood LPL at connector C008, Pin B. Refer to *Engine Control Schematics.* 9. Run the engine until normal operating temperature is reached. 10. Using a scan tool monitor the HO2S B2 S1 voltage. Is the HO2S voltage fixed less than the value specified?	78 mV	Go to *Step 7*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
7	7. Turn the ignition OFF. 8. Disconnect the HO2S B2 S1 connector. 9. Leave the AF ECM disconnected. 10. Jumper the HO2S low circuit terminal (engine harness side) to a known good ground. 11. Turn the ignition ON while leaving the engine OFF. 12. Using a scan tool monitor the HO2S B2 S1 voltage. Is the HO2S voltage within the value range specified?	351 to 551 mV	Go to *Step 8*	Go to *Step 9*
8	2. The HO2S may be detecting a lean exhaust condition. Inspect for one of the following conditions: • HO2S connector water intrusion • Exhaust leak between the HO2S and the engine. • Vacuum leaks • An inaccurate MAF sensor 3. Repair any of the above or similar engine conditions as necessary. Was a condition found and repair?	—	Go to *Step 16*	Go to *Step 14*
9	6. Turn the ignition OFF. 7. Remove the jumper from the HO2S low circuit terminal. 8. Disconnect the PCM connector that contains the HO2S B2 S1 high signal circuit. 9. Using a DVOM, measure and record the resistance between the HO2S high signal circuit and ground. 10. Using a DVOM, measure and record the resistance between the HO2S high signal circuit and the HO2S low circuit. Is infinite resistance measured on both tests?	—	Go to *Step 15*	Go to *Step 10*
10	Repair the HO2S signal circuit high circuit shorted to ground or shorted to the HO2S low circuit. Is the action complete?	—	Go to *Step 16*	—
11	5. Test the HO2S high and low circuits for continuity between the engine harness circuit splices and the AF ECM connector terminals. 6. Measure for continuity between the oxygen sensor connector and the AF ECM connector. 7. Test for proper terminal contact at the AF ECM connector terminals and at the 10-way LPG harness to engine harness connector terminals. 8. Repair wiring or terminals as necessary. Was a wiring or terminal repair made?	—	Go to *Step 16*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
12	The HO2S may be detecting a lean exhaust. Perform the *AF Fuel System Diagnosis* and return to this step. Was a lean AF fuel system condition found and repaired?	—	Go to *Step 16*	Go to *Step 13*
13	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 16*	—
14	Replace the HO2S. Refer to *HO2S Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 16*	—
15	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 3. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 4. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 16*	—
16	6. Reconnect all disconnected or removed components, connectors, LPL test jumper, fuses, etc. 7. Using the scan tool, clear the DTC information from BOTH control modules. 8. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 9. Operate the vehicle under the Conditions for Running the DTC. 10. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0152 (DTC 65) HO2S Circuit High Voltage Bank 2 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV). The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.

This DTC is used to indicate an HO2S signal voltage that is above the normal operating range of the sensor. This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- Engine coolant temperature is greater than 160°F (70°C).
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage of greater than 1.0 volt (1000 mV) for 5 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 1 Sensor 1 signal. If a Bank 1 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Always diagnose **ANY** PCM codes that are present before beginning this diagnostic procedure.

Check the following items:

- Fuel pressure - The ECM can compensate for small increases in fuel pressure. However, large increases in fuel pressure may set a DTC.
- Faulty Fuel Control Solenoid (FCS).
- Vacuum leaks in the fuel control valve hoses.
- False rich indication due to silicon contamination of the HO2S. This will be accompanied by lean driveability conditions and a powdery white deposit on the sensor.
- Faulty HO2S (Bank 2 Sensor 1). If the HO2S (Bank 2 Sensor 1) is internally shorted, the HO2S (Bank 2 Sensor 1) voltage displayed will be over 1V. Try disconnecting the HO2S (Bank 2 Sensor 1); if the displayed voltage goes from over 1000 mV to around 450 mV, replace HO2S (Bank 2 Sensor 1).
- Never solder the HO2S wires.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

3. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.
8. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.

DTC P0152 (DTC 65) HO2S Circuit High Voltage Bank 2 Sensor 1

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	4. Run the engine until normal operating temperature is reached. 5. Using a scan tool, establish communication with the AF ECM. 6. Using a scan tool, monitor the AF ECM HO2S B2 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 5*	Go to *Step 3*

3	2. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently shorted to voltage.
	• A silicon contaminated HO2S.
	• An intermittent rich condition such as the following:
	  • Incorrect fuel pressure
	  • Low coolant level / cooling system not bled at LPR
	  • Leaking low pressure regulator (LPR)
	  • Rich condition at fuel mixer
	  • Rich condition at FCS
	  • Rich condition at ICS
	  • An inaccurate MAF sensor
	3. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 15*	Go to *Step 4*

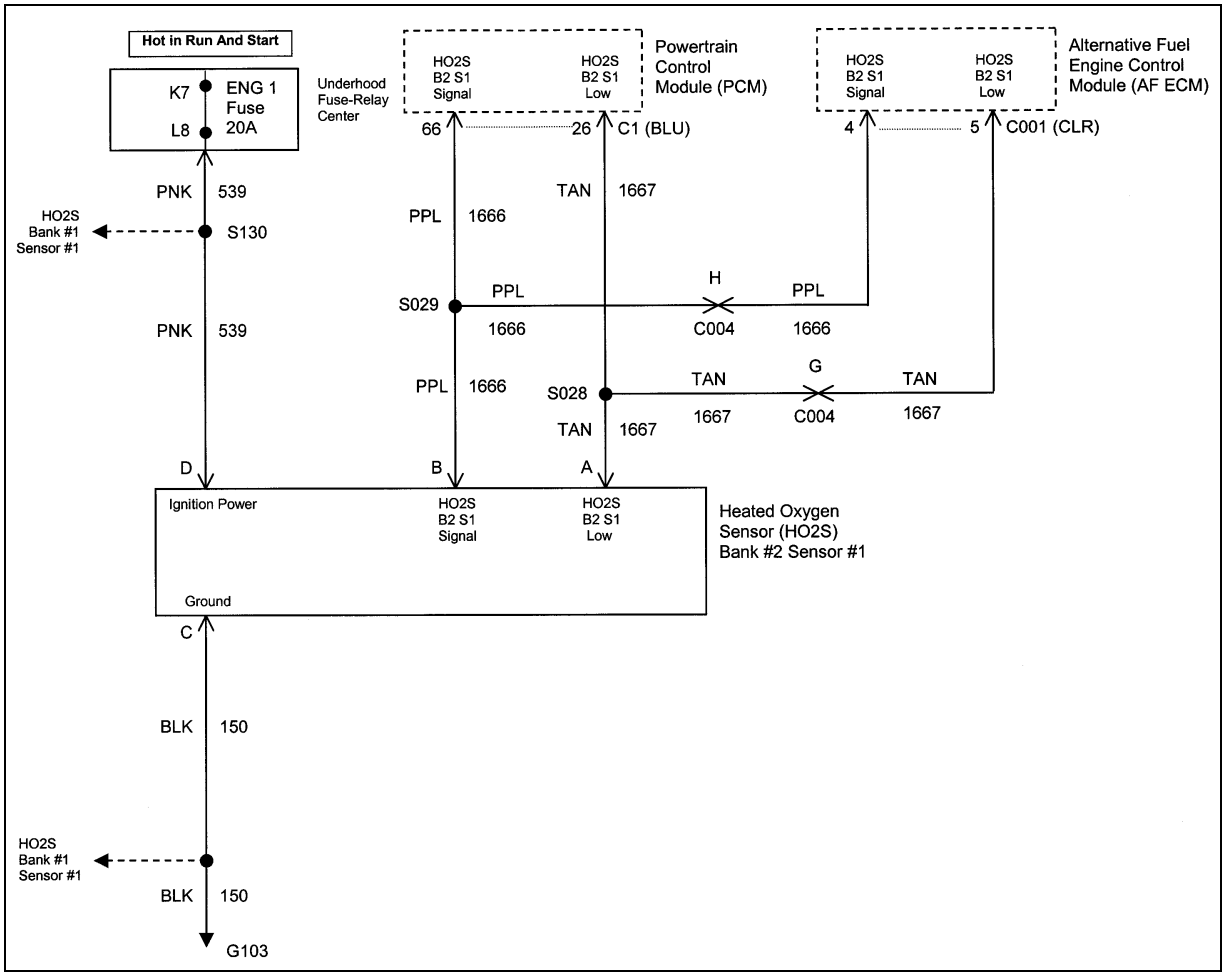
4	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
5	4. Run the engine until normal operating temperature is reached. 5. Using the scan tool, establish communication with the PCM. 6. Using a scan tool, monitor the HO2S B2 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 6*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
6	6. Turn the ignition OFF. 7. Disconnect the AF ECM connectors. 8. Install a ground jumper wire to the underhood LPL at connector C008, Pin B. Refer to *Engine Control Schematics.* 9. Run the engine until normal operating temperature is reached. 10. Using a scan tool, monitor the HO2S B2 S1 voltage. Is the HO2S voltage fixed greater than the value specified?	1.0 volts	Go to *Step 7*	Go to *Step 11*
7	7. Turn the ignition OFF. 8. Disconnect the HO2S B2 S1 connector. 9. Leave the AF ECM disconnected. 10. Jumper the HO2S low circuit terminal (engine harness side) to a known good ground. 11. Turn the ignition ON while leaving the engine OFF. 12. Using a scan tool monitor the HO2S B2 S1 voltage. Is the HO2S voltage within the value range specified?	351 to 551 mV	Go to *Step 8*	Go to *Step 9*
8	3. The HO2S may be detecting a rich exhaust condition. Inspect for one of the following conditions: • HO2S connector water intrusion • Silicone contaminated HO2S • Fuel contaminated engine oil • Incorrect fuel pressure • Low coolant level / cooling system not bled at LPR • Leaking low pressure regulator (LPR) • Rich condition at fuel mixer • Rich condition at FCS • Rich condition at ICS • An inaccurate MAF sensor 4. Repair any of the above or similar engine conditions as necessary. Was a condition found and repair?	—	Go to *Step 15*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
9	6. Turn the ignition OFF. 7. Remove the jumper from the HO2S low circuit terminal. 8. Disconnect the PCM connector that contains the HO2S B2 S1 high signal circuit. 9. Turn the ignition ON leaving the engine OFF. 10. Using a DVOM, measure and record the voltage between the HO2S high signal circuit and ground. Is the voltage measured greater than the value specified?	20 mV	Go to *Step 10*	Go to *Step 14*
10	Repair the HO2S signal circuit high circuit shorted to voltage. Is the action complete?	—	Go to *Step 15*	—
11	The HO2S may be detecting a rich exhaust condition. Perform the *AF Fuel System Diagnosis* and return to this step. Was a rich AF fuel system condition found and repaired?	—	Go to *Step 15*	Go to *Step 12*
12	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 15*	—
13	Replace the HO2S. Refer to *HO2S Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 15*	—
14	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 15*	—

Step	Action	Value(s)	Yes	No
15	6. Reconnect all disconnected or removed components, connectors, LPL test jumper, fuses, etc. 7. Using the scan tool, clear the DTC information from BOTH control modules. 8. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 9. Operate the vehicle under the Conditions for Running the DTC. 10. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0154 (DTC 63) HO2S Circuit Insufficient Activity Bank 2 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV.
This DTC is used to indicate an HO2S signal voltage that is below the normal operating range of the sensor.
During normal closed loop operation, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust. The AF ECM will remove fuel (lean the mixture) when the HO2S indicates a rich exhaust. This oscillation above and below the bias voltage (sometimes referred to as activity or switching) can be monitored with the HO2S signal voltage.
The oxygen sensor contains a heater. The heater quickly warms the sensor to operating temperature. The heater will also maintain operating sensor temperature during extended idle conditions.
This DTC is used to indicate an HO2S with in-active signal voltage.
This DTC is a type B DTC.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- The engine has been operating for at least 1 minute.
- The oxygen sensor has been at operating temperature for at least 30 seconds. The engine coolant temperature must be greater than 50°C AND the mass air flow above 4.4 gms/sec for at least 30 seconds for the AF ECM to determine the HO2S is at operating temperature.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage stuck between 0.300 V and 0.600 V (in-active) for 8 seconds continuously
OR
The AF ECM monitors an HO2S signal voltage between 0.00 V and 1.0 V that has not performed a rich / lean switch for 8 seconds continuously.

Action Taken When the DTC Sets

The AF ECM will control fuel trim based upon the Bank 1 Sensor 1 signal. If a Bank 1 Sensor 1 DTC sets, the AF ECM will operate in open loop fuel control.

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks
Check the following conditions:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.
- A poor connection or a damaged harness
- Backed out terminals
- Improperly formed or damaged terminals
- Poor terminal to wire connection
- Damaged harness
- A poor ECM to the engine block ground.
- Faulty Idle Control Solenoid (ICS) or ICS circuit.
- Faulty Fuel Control Solenoid (FCS) or FCS circuit.
- Faulty fuel mixer.
- Faulty Low Pressure Regulator (LPR).
- Exhaust leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum or crankcase leaks can cause a lean condition or possibly a high idle.
- If the above check out okay, the problem may be a faulty heated sensor.
- A faulty HO2S (Bank 2, Sensor 1) heater or heater circuit. With the ignition switch on but the engine off, the HO2S (Bank 2, Sensor 1) voltage displayed on a scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly.
  If not, disconnect the HO2S (Bank 2, Sensor 1) and connect a test lamp between the terminals *"C" and "D"*. If the test lamp does not light, repair the open in the HO2S (Bank 2, Sensor 1) ground circuit or the HO2S (Bank 2, Sensor 1) ignition feed circuit. If the test lamp lights, replace the HO2S (Bank 2, Sensor 1).
- The intermittent test - With a scan tool, monitor the HO2S (Bank 2, sensor 1) signal voltage while moving the related connectors and the wiring harness with a warm engine running at part throttle in closed loop. If the failure is induced, the HO2S (Bank 2, Sensor 1) signal voltage reading changes from its normal fluctuating voltage (above 600 mV and below 300 mV) to a fixed value around 450 mV. This may help isolate the location of the malfunction.
- Never solder the HO2S wires. For proper wire and connector repair, refer to Wiring Repairs in Engine Electrical.

Test Description

The number(s) below refer to the step numbers on the diagnostic table.
2. This step determines if proper sensor activity us present. When in closed loop fuel control, the

HO2S voltage should rapidly swing above the bias voltage.

6. This step determines if the PCM and the high and low circuits between the PCM and HO2S connector are operating properly.
9. This step determines if the HO2S heater circuit operates correctly up to the HO2S connector.
10. This step determines if the proper circuit resistance exists between the HO2S low circuit and the PCM ground.
15. This step determines if the proper circuit resistance exists between the HO2S low circuit and the PCM ground with a cold sensor. A loose HO2S or poor cold thread to exhaust electrical contact will cause higher resistance when the HO2S is cold. Although 500 ohms is allowed, typical resistance should be less than 50 ohms.

DTC P0154 (DTC 63) HO2S Insufficient Activity Bank 2 Sensor 1

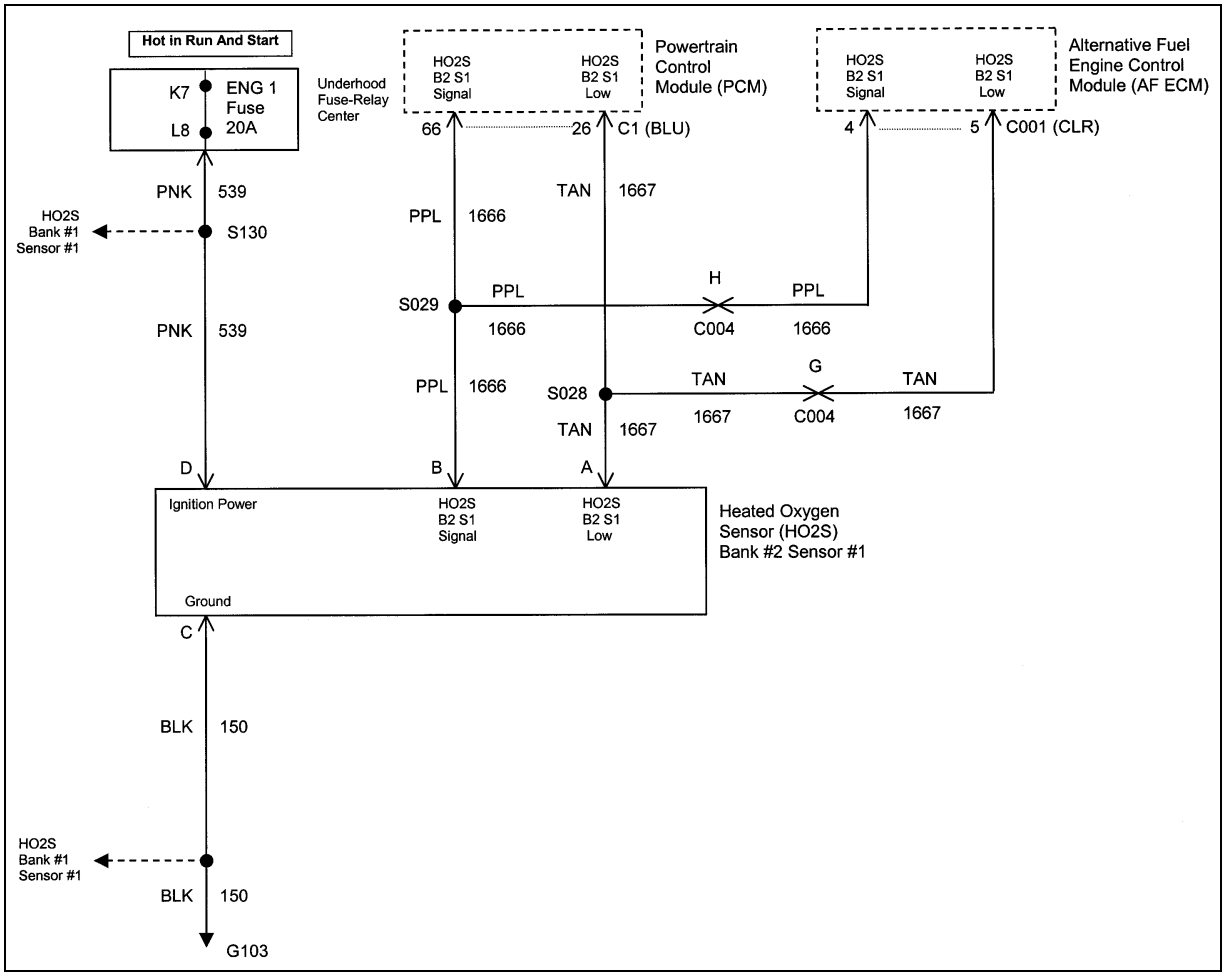
Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Use a scan tool to establish communication with the AF ECM. 2. Capture the DTC information from the AF ECM in the scan tool. 3. Clear the DTC information using the scan tool. 4. Reset the fuel trim values. 5. Start and idle the engine until normal operating temperature is reached. 6. Use the scan tool to monitor the HO2S B2 S1 voltage. Is the voltage fixed within the specified range?	0.1 to 1.0 volts	Go to *Step 5*	Go to *Step 3*
3	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions: • Water intrusion of the HO2S connector. • An intermittently open HO2S high signal circuit • An intermittently open HO2S low circuit • An HO2S low circuit with high resistance to ground • Any AF ECM ground circuits with high resistance to ground • An inoperative HO2S heater • A faulty HO2S or PCM terminal contact • An exhaust system leak (typically within 12 inches upstream of the HO2S). • A defective HO2S 2. Repair any of the above conditions as necessary. Was a condition found and repaired?	—	Go to *Step 22*	Go to *Step 4*
4	The fault is not present. Refer to *Diagnostic Aids.* Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*

Step	Action	Value(s)	Yes	No
5	1. Use a scan tool to establish communication with the AF ECM. 2. Start and idle the engine until normal operating temperature is reached. 3. Use the scan tool to monitor the HO2S B2 S1 voltage. Is the voltage fixed within the specified range?	0.10 to 1.0 volts	Go to *Step 6*	Go to *Step 17*
6	1. Turn the ignition OFF. 2. Disconnect the HO2S B2 S1 electrical connector. 3. Jumper the HO2S low circuit to a known good ground. 4. Jumper the HO2S high signal circuit to a know good ground. 5. Turn the ignition ON leaving the engine OFF. 6. Use the scan tool to monitor the HO2S B2 S1 voltage. Is the voltage less than the specified value?	20 mV	Go to *Step 9*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Remove the jumpers from the HO2S terminals. 3. Disconnect the PCM connector containing the HO2S high and low circuits. 4. Use a DVOM to measure continuity of the HO2S high signal circuit and HO2S low signal circuit between the PCM connector and the HO2S connector terminal (engine harness side). Are both resistances less than the specified value?	5 ohms	Go to *Step 8*	Go to *Step 11*
8	1. Inspect for proper PCM connector terminal contact. 2. Repair the terminals as necessary. Was a terminal repair made?	—	Go to *Step 22*	Go to *Step 21*
9	1. Remove the jumpers from the HO2S terminals. 2. Connect a test lamp between the HO2S heater ignition feed and heater ground circuit terminals (engine harness side). 3. Turn the ignition ON leaving the engine OFF. Does the test lamp illuminate?	—	Go to *Step 10*	Go to *Step 12*
10	1. Turn the ignition OFF. 2. Reconnect the HO2S connector. 3. Disconnect the PCM connector containing the HO2S low circuit and the PCM connector containing the PCM ground circuits. 4. Using a DVOM, measure the resistance between the HO2S low circuit terminal and one of the PCM grounds. Is the resistance less than the specified value?	500 ohms	Go to *Step 14*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
11	Repair the circuit that measured high resistance. Did you complete the repair?	—	Go to *Step 17*	—
12	Repair the HO2S heater ignition or ground circuit. Possible causes include the following: • An open circuit • A high circuit resistance • A faulty ground connection • A blown heater fuse (other DTCs may be set) Did you complete the repair?	—	Go to *Step 22*	—
13	Repair the high resistance between the HO2S low circuit and the PCM ground circuit. Possible causes include the following: • A faulty HO2S connector terminal contact • An open sensor harness low circuit (requires HO2S replacement) • A sensor harness low circuit with high resistance (requires HO2S replacement) • A faulty PCM ground connection • A high PCM ground circuit resistance • An ungrounded exhaust system Did you complete the repair?	—	Go to *Step 22*	—
14	1. Inspect for exhaust system leaks upstream of the suspect HO2S. The leak may be very small and is typically within 12 inches of the HO2S. 2. Repair the exhaust as necessary. Was an exhaust system repair made?	—	Go to *Step 22*	Go to *Step 15*
15	1. Allow the engine to cool to ambient temperature. 2. Using a DVOM, re-measure the resistance between the HO2S low circuit terminal and a PCM ground circuit terminal. Is the resistance less than the specified value?	500 ohms	Go to *Step 19*	Go to *Step 16*
16	1. Remove the HO2S from the exhaust. 2. Clean the HO2S mounting threads. 3. Apply HO2S safe anti-seize compound to the sensor threads. 4. Tighten the HO2S to the proper torque. Refer to *HO2S Replacement* in the GM G Van service manual. 5. Using a DVOM, measure the resistance between the HO2S low circuit terminal and a PCM ground circuit terminal. Is the resistance less than the specified value?	500 ohms	Go to *Step 22*	Go to *Step 20*

Step	Action	Value(s)	Yes	No
17	1. Inspect the oxygen sensor signal and low circuit for continuity between the AF ECM connector terminals and the oxygen sensor connector terminal. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, PCM and the AF ECM connectors are disconnected before testing the circuits. 3. Repair the wiring as necessary. Was a wire repair made?	—	Go to *Step 22*	Go to *Step 18*
18	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 22*	—
19	Perform the AF Fuel System diagnosis and return to this step. Refer to *AF Fuel System Diagnosis*? Was an LPG fuel system problem found and repaired?	—	Go to *Step 22*	Go to *Step 20*
20	Replace the HO2S. Refer to *HO2S Replacement* in the GM G Van service manual. Did you complete the repair?	—	Go to *Step 22*	—
21	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 22*	—
22	1. Reconnect all disconnected or removed components, connectors, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0155 (DTC 62) HO2S Heater Performance Bank 2 Sensor 1



Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The PCM supplies a bias or reference voltage to the HO2S. This bias voltage is around 450 mV. The AF ECM monitors the bias voltage as well as the voltage produced by the HO2S.

During normal closed loop fuel control, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust content. When the HO2S indicates a rich exhaust content, the AF ECM will add fuel (lean the mixture). This oscillation above and below the bias voltage (sometimes referred to as activity or switching) can be monitored with the HO2S signal voltage.

The oxygen sensor contains a heater. The heater is used to quickly warm the sensor to operating temperature. The heater will also maintain operating sensor temperature during extended idle conditions. A functions oxygen sensor heater will allow the sensor to produce voltage in less time. A sensor at operating temperature will cause the HO2S signal voltage to go above or below (depending upon exhaust oxygen content) the bias voltage.

This DTC is used to indicate an HO2S signal voltage that did not leave the cold sensor bias voltage range in an acceptable amount of time. This DTC is a type B DTC.

Conditions for Running the DTC

- AF ECM DTCs P0117 (15), P0118 (14), P0125 (16), P0151 (64), P0152 (65), P0154 (63) are not set.

- The start-up engine coolant temperature is less than 91°F (33°C).
- The engine has been operating for at least five seconds.
- The average mass air flow is less than 35 grams per second.
- All other AF ECM DTCs for this HO2S sensor have ran and passed.
- This DTC has not tested this ignition cycle.
- The AF ECM determines the HO2S was cold at ignition key ON. The average HO2S signal voltage must be within the bias voltage range of 0.30 volts (300 mV) to 0.60 volts (600 mV) for the AF ECM to determine the HO2S was cold.

Conditions for Setting the DTC

The AF ECM monitors an HO2S signal voltage that did not leave the cold sensor bias voltage range of 0.30 volts (300 mV) to 0.060 volts (600 mV) in an acceptable amount of time. The time varies from 50 seconds to 110 seconds based upon mass air flow.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Check for the following condition:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description
The numbers below refer to the step numbers on the diagnostic table.

2. As the heater warms the oxygen sensor to operating temperature, the HO2S will output a voltage in relation to the amount of oxygen in the exhaust. With the ignition ON and the engine OFF, the exhaust usually contains a high oxygen content. With the engine OFF, the HO2S voltage will usually decrease from the initial (bias) voltage due to the high oxygen content.
6. This step test for proper HO2S heater ignition power and ground supply.
7. This step tests for proper PCM and signal circuit operation.

DTC P0155 (DTC 62) HO2S Heater Performance Bank 2 Sensor 1

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*

Step	Action	Value(s)	Yes	No
2	**Important:** The HO2S must be cool before proceeding with this diagnosis. The ignition must remain OFF for at least on half hour before proceeding with the diagnosis. 1. Connect a scan tool. 2. Set-up the scan tool with the proper vehicle identification prior to turning the ignition ON. Establish communication with the PCM. 3. Turn the ignition ON, leaving the engine OFF, and as quickly as possible observe and record the HO2S voltage for the sensor that applies to this DTC. 4. Observe the HO2S voltage for two minutes. Does the HO2S voltage increase or decrease from the initial voltage by at least the specified value?	150 mV	Go to *Step 3*	Go to *Step 6*
3	1. Allow the HO2S voltage to stabilize. 2. Use the scan tool to observe and record the current HO2S voltage from the PCM. 3. Use the scan tool to establish communication with the AF ECM. 4. Use the scan tool to observe and record the current voltage from the AF ECM for the HO2S B2 S1. Does the AF ECM indicate the same HO2S voltage as the PCM, plus or minus the specified value?	45 mV	Go to *Step 4*	Go to *Step 14*
4	The condition that set this DTC is not present. This DTC may have been set by one of the following conditions: • An intermittently open or high resistance HO2S high signal circuit or low circuit. • An intermittently open or high resistance HO2S heater feed or ground circuit. • A faulty HO2S or gasoline PCM terminal contact. • A defective HO2S. • Repair any of the above conditions as necessary. Was a condition found and repaired?	—	Go to *Step 18*	Go to *Step 5*
5	The fault is not present. Refer to *Diagnostic Aids*. Are any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
6	1. Turn the ignition OFF. 2. Disconnect the HO2S B2 S1 connector. 3. Connect an un-powered test lamp between the HO2S heater ignition feed and ground circuit terminals (engine harness side). 4. Turn the ignition ON leaving the engine OFF. Does the test lamp illuminate?	—	Go to *Step 7*	Go to *Step 8*

Step	Action	Value(s)	Yes	No
7	1. Disconnect the test lamp. 2. Jumper the HO2S low circuit terminal to a known good ground. 3. Jumper the HO2S high circuit terminal to a known good ground. 4. Use the scan tool to monitor the HO2S B2 S1 voltage. Ensure the ignition is ON while the engine is OFF. Is the voltage less than the specified range?	20 mV	Go to *Step 10*	Go to *Step 9*
8	Connect the test lamp between the HO2S heater ignition feed circuit terminal (engine harness side) and a known good ground. Ensure the ignition is ON while the engine is OFF. Does the test lamp illuminate?	—	Go to *Step 11*	Go to *Step 12*
9	1. Turn the ignition OFF. 2. Remove the jumpers from the HO2S terminals. 3. Disconnect the PCM connector containing the HO2S high and low circuits. 4. Using a DVOM, measure the continuity of the HO2S high signal circuit and the HO2S low signal circuit between the PCM and the HO2S connector terminal (engine harness side). Are both resistances less than the specified value?	5 ohms	Go to *Step 16*	Go to *Step 13*
10	Replace the HO2S sensor. Refer to *Heated Oxygen Sensor (HO2S) Replacement* in the GM G Van service manual. Is the action complete?	—	Go to *Step 18*	—
11	Repair the open HO2S heater ground circuit Is the action complete?	—	Go to *Step 18*	—
12	1. Repair the lack of power on the HO2S heater ignition feed circuit. 2. If the fuse is open, repair the short to ground on the circuit. An open fuse or lack of power to the fuse may cause other DTCs or symptoms to be present. Is the action complete?	—	Go to *Step 18*	—
13	Repair the circuit that measured high resistance. Is the action complete?	—	Go to *Step 18*	—

Step	Action	Value(s)	Yes	No
14	1. Inspect the HO2S sensor signal and low circuit for continuity between the AF ECM connector terminals and the HO2S connector terminals. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, gasoline control module and the AF ECM connectors are disconnected before testing circuits. 3. Repair the wiring as necessary. Was a problem found?	—	Go to *Step 18*	Go to *Step 15*
15	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 18*	—
16	1. Inspect for proper PCM terminal contact. 2. Repair the terminals as necessary. Was a problem found and repaired?	—	Go to *Step 18*	Go to *Step 17*
17	**Important!** **The following PCM replacement procedures must be completed before attempting to operate the vehicle.** 1. Replace the PCM. Refer to *PCM Replacement* in Engine Controls in the GM G Van service manual. 2. Program (flash) the replacement PCM with the correct LPG software and calibration. Is the replacement complete?	—	Go to *Step 18*	—
18	**Important!** The HO2S must be cool before proceeding with this diagnosis. The ignition must remain OFF for at least one half hour before proceeding with diagnosis. 1. Connect a scan tool. 2. Set-up the scan tool with the proper vehicle identification information prior to turning the ignition ON. 3. Turn the ignition ON, leaving the engine OFF, and as quickly as possible observe and record the HO2S voltage for the sensor that applies to this DTC. 4. Observe the HO2S voltage for 2 minutes. Does the voltage increase or decrease from the initial voltage by at least the specified value?	150 mV	System OK	Go to *Step 2*

DTC P0171 (DTC 55) Fuel Trim System Lean

Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The AF ECM utilizes a closed loop fuel air-fuel metering system when the HO2S is at operating temperature. During normal closed loop operation, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust. The AF ECM will remove fuel (lean the mixture) when the HO2S indicates a rich exhaust. This addition and removal to the air/fuel mixture is indicated on the scan tool as the long and short term fuel trim values. Short term fuel trim values are adjustments to the air/fuel mixture that occur quickly. Long term values are adjustments to the air/fuel mixture that accumulate over longer periods of time. The long and short term fuel trim values are displayed on a scan tool as both percent and counts. A positive percentage value indicates fuel is being added to the mixture. A negative percentage value indicates fuel is being removed form the mixture.
This DTC is used to indicate a fully rich fuel trim system that cannot compensate for a lean engine exhaust content.
This DTC is a type B DTC.

Conditions for Running the DTC

- The engine coolant temperature is greater than 185°F (85°C).
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors that the short term fuel trim is at +100 percent or long term fuel trim is at +50 percent for at least 5 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Check for the following conditions:

- Low or empty LPG fuel tank. For proper LPG fuel system operation, liquid fuel is required at the LPR inlet. If the fuel level becomes so low that fuel vapor is delivered to the LPR inlet, the air-fuel mixture will be lean and the MIL may illuminate. Also, the vehicle will start and idle normally but hesitate and stumble under load. If the DTC is current, verify that the fuel tank is at least ¼ full. If the DTC is stored in history, verify with the operator if the vehicle has recently been run low or out of fuel.

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Always diagnose **ANY** PCM codes that are present before beginning this diagnostic procedure.
Check the following items:

- Faulty Idle Control Solenoid (ICS) or ICS circuit.
- Faulty Fuel Control Solenoid (FCS) or FCS circuit.
- Faulty fuel mixer
- Faulty LPR

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4. The engine may also have a higher than normal idle if a vacuum leak is present.
8. When testing the circuits for continuity, the resistance should be less than 5 ohms. When testing the circuits for shorts, the resistance should measure infinite with all components disconnected form the circuit.
9. The step determines if a base engine concern is causing the rich condition.

DTC P0171 (DTC 55) Fuel Trim System Lean

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Connect the scan tool. 2. Capture the DTC information from the AF ECM in the scan tool. 3. Inspect both the AF ECM and the PCM for other stored DTCs. Are other DTCs stored?	—	Go to *Step 3*	Go to *Step 4*
3	Perform the other DTC diagnosis before attempting diagnosis of this DTC. Is the other DTC diagnosis and/or repair complete?	—	Go to *Step 12*	—

4	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently open or shorted to ground.
	• HO2S connector water intrusion.
	• A lean condition such as the following:
	  • Incorrect LPG fuel pressure
	  • Vacuum leaks
	  • Faulty Idle Control Solenoid (ICS) or ICS circuit.
	  • Faulty Fuel Control Solenoid (FCS) or FCS circuit.
	  • A restricted low pressure regulator (LPR)
	  • A lean fuel mixer
	  • An inaccurate MAF sensor
	  • An intake air duct leak between the MAF sensor and the throttle.
	  • Exhaust system leaks between then engine and the oxygen sensors.
	2. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 12*	Go to *Step 5*

Step	Action	Value(s)	Yes	No
5	1. Reconnect all disconnected or removed components. 2. Using the scan tool, clear all DTC information form both the PCM and the AF ECM. 3. Using the scan tool, communicate with the AF ECM and reset the fuel trim values to zero. 4. Turn the ignition OFF and wait 30 seconds. 5. Start the engine. 6. View the captured freeze frame data that was stored in Step 2. Observe the data parameters that give an indication of how the vehicle was being operated when this DTC set. 7. Operate the vehicle within the conditions for running the DTC and the parameters observed when the DTC set. 8. Observe the short term fuel trim values. Do the fuel trim values indicate a lean mixture condition is present or does a fuel trim DTC set?	—	*Go to Step 7*	Go to *Step 6*
6	The fault is not present. Refer to *Diagnostic Aids.* Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
7	Perform the AF Fuel System diagnosis and return to this step. Refer to *AF Fuel System* diagnosis. Was a LPG fuel system problem found and repaired?	—	Go to *Step 12*	Go to *Step 8*
8	1. Inspect the oxygen sensor signal and low circuits for continuity between the AF ECM connector terminals and the oxygen sensor connector terminals. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, PCM and the AF ECM connectors are disconnected before testing circuits. 3. Repair the wiring as necessary. Was a wiring repair made?	—	Go to *Step 12*	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	1. Reconnect all disconnected or removed components. 2. Using the scan tool, clear all DTC information from both the PCM and the AF ECM. 3. Using the scan tool, communicate with the AF ECM and reset the fuel trim values to zero. 4. Turn the ignition OFF and wait 30 seconds. 5. Start the engine. 6. View the captured freeze frame data that was stored in Step 2. Observe the data parameters that give an indication of how the vehicle was being operated when this DTC set. 7. Operate the vehicle within the conditions for running the DTC and the parameters observed when the DTC set. 8. Observe the short term fuel trim values. Do the fuel trim values indicate a lean mixture condition is present or does a fuel trim DTC set?	—	Go to *Step 10*	Go to *Step 11*
10	Repair the possible causes of lean engine operation. Refer to the items in *Step 4.* Is the repair?	—	Go to *Step 12*	—
11	Replace the fuel mixer. Refer to *Fuel Mixer Replacement.* Is the replacement complete?	—	Go to *Step 12*	—
12	1. Reconnect all disconnected or removed components, connectors, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0172 (DTC 56) Fuel Trim System Rich

Circuit Description

The heated oxygen sensor is used to determine the oxygen content of the engine's exhaust. The oxygen content indicates when the engine is operating lean or rich. When the engine is operating lean, the exhaust will have more oxygen content. Once at operating temperature, the HO2S will produce a voltage in relation to the oxygen content of the exhaust. The HO2S requires an operating temperature of 600°F (360°C) to produce voltage. The HO2S will produce more voltage when the exhaust is rich and less voltage when the exhaust is lean. The HO2S operating range is around 0.10 volts (100 mV) to 1 volt (1000 mV).
The AF ECM utilizes a closed loop fuel air-fuel metering system when the HO2S is at operating temperature. During normal closed loop operation, the AF ECM will add fuel (richen the mixture) when the HO2S indicates a lean exhaust. The AF ECM will remove fuel (lean the mixture) when the HO2S indicates a rich exhaust. This addition and removal to the air/fuel mixture is indicated on the scan tool as the long and short term fuel trim values. Short term fuel trim values are adjustments to the air/fuel mixture that occur quickly. Long term values are adjustments to the air/fuel mixture that accumulate over longer periods of time. The long and short term fuel trim values are displayed on a scan tool as both percent and counts. A positive percentage value indicates fuel is being added to the mixture. A Negative percentage value indicates fuel is being removed form the mixture.
This DTC is used to indicate a fully lean fuel trim system that cannot compensate for a rich engine exhaust content.
This DTC is a type B DTC.

Conditions for Running the DTC

- The engine coolant temperature is greater than 185°F (85°C).
- The AF ECM is operating in closed loop fuel control.

Conditions for Setting the DTC

The AF ECM monitors that the short term fuel trim is at –100 percent or long term fuel trim is at –50 percent for at least 5 seconds continuously.

Action Taken When the DTC Sets

- A first failure of this DTC will NOT illuminate the MIL and will store as Last Test Failed but not as History.
- The AF ECM will illuminate the MIL and store the DTC as History TWO consecutive drive trips that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Always diagnose **ANY** PCM codes that are present before beginning this diagnostic procedure.
Check the following items:

- Faulty Idle Control Solenoid (ICS) or ICS circuit.
- Faulty Fuel Control Solenoid (FCS) or FCS circuit.
- Faulty fuel mixer
- Faulty LPR

Test Description
The numbers below refer to the step numbers on the diagnostic table.

4. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.
8. When testing the circuits for continuity, the resistance should be less than 5 ohms. When

testing the circuits for shorts, the resistance should measure infinite with all components disconnected form the circuit.

9. The step determines if a base engine concern is causing the rich condition.
10. An HO2S contaminated by silicon will have a white, powdery deposit on the portion of the HO2S that is exposed to the exhaust stream. The usual cause of the silica contamination is the use of unapproved silicon RTV engine gasket material or the use of silicon based sprays or fluids within the engine. If the cause of this contamination is not corrected, the replacement HO2S will also become contaminated.

DTC P0172 (DTC 56) Fuel Trim System Rich

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Connect the scan tool. 2. Capture the DTC information from the AF ECM in the scan tool. 3. Inspect both the AF ECM and the PCM for other stored DTCs. Are other DTCs stored?	—	Go to *Step 3*	Go to *Step 4*
3	Perform the other DTC diagnosis before attempting diagnosis of this DTC. Is the other DTC diagnosis and/or repair complete?	—	Go to *Step 14*	—

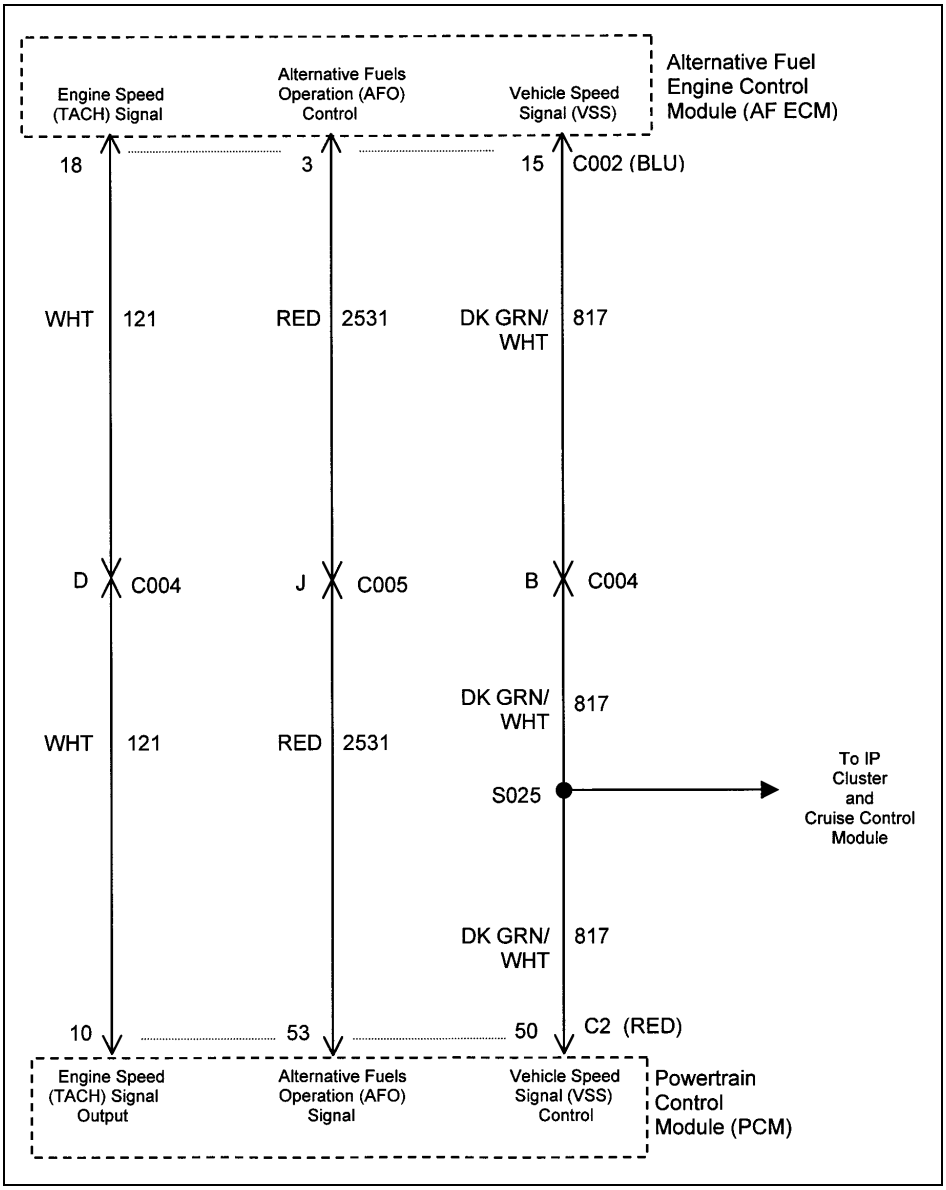
4	1. The condition that set this DTC is not present. This DTC may have been set by one of the following conditions:
	• A signal wire intermittently shorted to voltage.
	• HO2S connector water intrusion.
	• A silicon contaminated HO2S.
	• An rich condition such as the following:
	  • Faulty Idle Control Solenoid (ICS) or ICS circuit.
	  • Faulty Fuel Control Solenoid (FCS) or FCS circuit.
	  • Incorrect LPG fuel pressure
	  • Low coolant level / cooling system not bled at LPR
	  • Leaking low pressure regulator (LPR)
	  • Rich condition at fuel mixer
	  • An inaccurate MAF sensor
	  • A restricted air filter or air intake duct
	2. Repair any of the above conditions as necessary.
	
	Was a condition found and repaired?
		—	*Go to Step 14*	Go to *Step 5*

Step	Action	Value(s)	Yes	No
5	1. Reconnect all disconnected or removed components. 2. Using the scan tool, clear all DTC information form both the PCM and the AF ECM. 3. Using the scan tool, communicate with the AF ECM and reset the fuel trim values to zero. 4. Turn the ignition OFF and wait 30 seconds. 5. Start the engine. 6. View the captured freeze frame data that was stored in Step 2. Observe the data parameters that give an indication of how the vehicle was being operated when this DTC set. 7. Operate the vehicle within the conditions for running the DTC and the parameters observed when the DTC set. 8. Observe the short term fuel trim values. Do the fuel trim values indicate a rich mixture condition is present or does a fuel trim DTC set?	—	*Go to Step 7*	Go to *Step 6*
6	The fault is not present. Refer to *Diagnostic Aids*. Are there any DTCs stored that have not been diagnosed?	—	Go to *AF DTC List*	Go to *Intermittents*
7	Perform the AF Fuel System diagnosis and return to this step. Refer to *AF Fuel System* diagnosis. Was a LPG fuel system problem found and repaired?	—	Go to *Step 14*	Go to *Step 8*
8	1. Inspect the oxygen sensor signal and low circuits for continuity between the AF ECM connector terminals and the oxygen sensor connector terminals. 2. Inspect these circuits for shorts to other circuits or to ground. Ensure the oxygen sensor, gasoline control module and the AF ECM connectors are disconnected before testing circuits. 3. Repair the wiring as necessary. Was a wiring repair made?	—	Go to *Step 14*	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	1. Reconnect all disconnected or removed components. 2. Using the scan tool, clear all DTC information form both the PCM and the AF ECM. 3. Using the scan tool, communicate with the AF ECM and reset the fuel trim values to zero. 4. Turn the ignition OFF and wait 30 seconds. 5. Start the engine. 6. View the captured freeze frame data that was stored in Step 2. Observe the data parameters that give an indication of how the vehicle was being operated when this DTC set. 7. Operate the vehicle within the conditions for running the DTC and the parameters observed when the DTC set. 8. Observe the short term fuel trim values. Do the fuel trim values indicate a rich mixture condition is present or does a fuel trim DTC set?	—	Go to *Step 10*	Go to *Step 13*
10	Remove and visually inspect the oxygen sensor for silicon contamination. Is the oxygen sensor contaminated?	—	Go to *Step 12*	Go to *Step 11*
11	Repair the possible causes of rich engine operation. Refer to the items in *Step 4.* Is the repair?	—	Go to *Step 14*	—
12	**Important!** **Before replacing a contaminated HO2S determine and repair the cause of the contamination.** Replace the HO2S. Refer to *HO2S Replacement* in Engine Controls in the GM G Van service manual. Is the replacement complete?	—	Go to *Step 14*	—
13	Replace the fuel mixer. Refer to *Fuel Mixer Replacement.* Is the replacement complete?	—	Go to *Step 14*	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all disconnected or removed components, connectors, fuses, etc. 2. Using the scan tool, clear the DTC information from BOTH control modules. 3. Using the scan tool, communicate with both control modules to reset the fuel trim values to zero. 4. Operate the vehicle under the Conditions for Running the DTC. 5. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	System OK	Go to *Step 2*

DTC P0336 (DTC 41) CKP Sensor Circuit Performance



Circuit Description

The PCM outputs an engine speed (tach) signal to the AF ECM. This RPM signal is determined by the PCM based on a signal from the crankshaft position (CKP) sensor signal. The CKP sensor is supplied with ignition voltage and ground. The CKP sensor is mounted near the crankshaft and monitors a toothed crankshaft reluctor wheel. As the crankshaft spins, the toothed reluctor wheel induces a signal to the CKP sensor. The PCM and the AF ECM use the CKP signal to determine engine speed, crankshaft position and if a cylinder misfire is present. This DTC is used to indicate no CKP reference signal is being monitored by the AF ECM while engine sensor condition indicate the crankshaft is rotating. This is a type A DTC.

Conditions for Running the DTC

- No AF ECM MAF sensor DTCs P0102 (36) or P0103 (37) are set during this ignition cycle.
- The MAP sensor signal indicates 105.23 kPa (31.07” Hg) or less.
- MAF is more than 3 gms/sec for 1 second continuously.
- The engine is cranking or running.

Conditions of Setting the DTC

The AF ECM monitors no CKP reference signal for more than 0.5 seconds.
NOTE: The AF ECM may run and set this DTC before the PCM.

Action Taken When the DTC Sets

- The AF ECM will illuminate the MIL and store the DTC as History during ONE drive trip that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

For this DTC, the AF ECM uses MAF sensor airflow values to determine when the engine is cranking or running. The PCM uses cam sensor pulses for the PCM DTC. An AF ECM DTC (but not a PCM DTC) would result during any condition (such as a disconnected MAF sensor) that causes airflow to be indicated with the ignition ON and the engine OFF.

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks
Check for the following conditions:
- A poor connection, a rubbed through wire insulation, or a wire that is broken inside the insulation may cause an intermittent problem.
- Inspect harness connectors for the following conditions:
  - Backed out terminals.
  - Improper mating.
  - Broken locks.
  - Improperly formed or damaged terminals.
  - Poor terminal to wire connection.
  - Physical damage to the wiring harness.

Inspect the face of the CKP sensor for metal shavings. This could result in an intermittent DTC. Refer to *Intermittents* in the powertrain diagnostics manual.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This step determines if the DTC is the result of a hard failure or an intermittent condition.
3. This step determines if the ECM is receiving the CKP sensor pulses.
6. This step checks the CKP sensor signal circuit for any unusual loading conditions. If the ECM is not receiving a signal and no circuit faults can be found. The PCM is not outputting a tachometer signal and should be diagnosed.

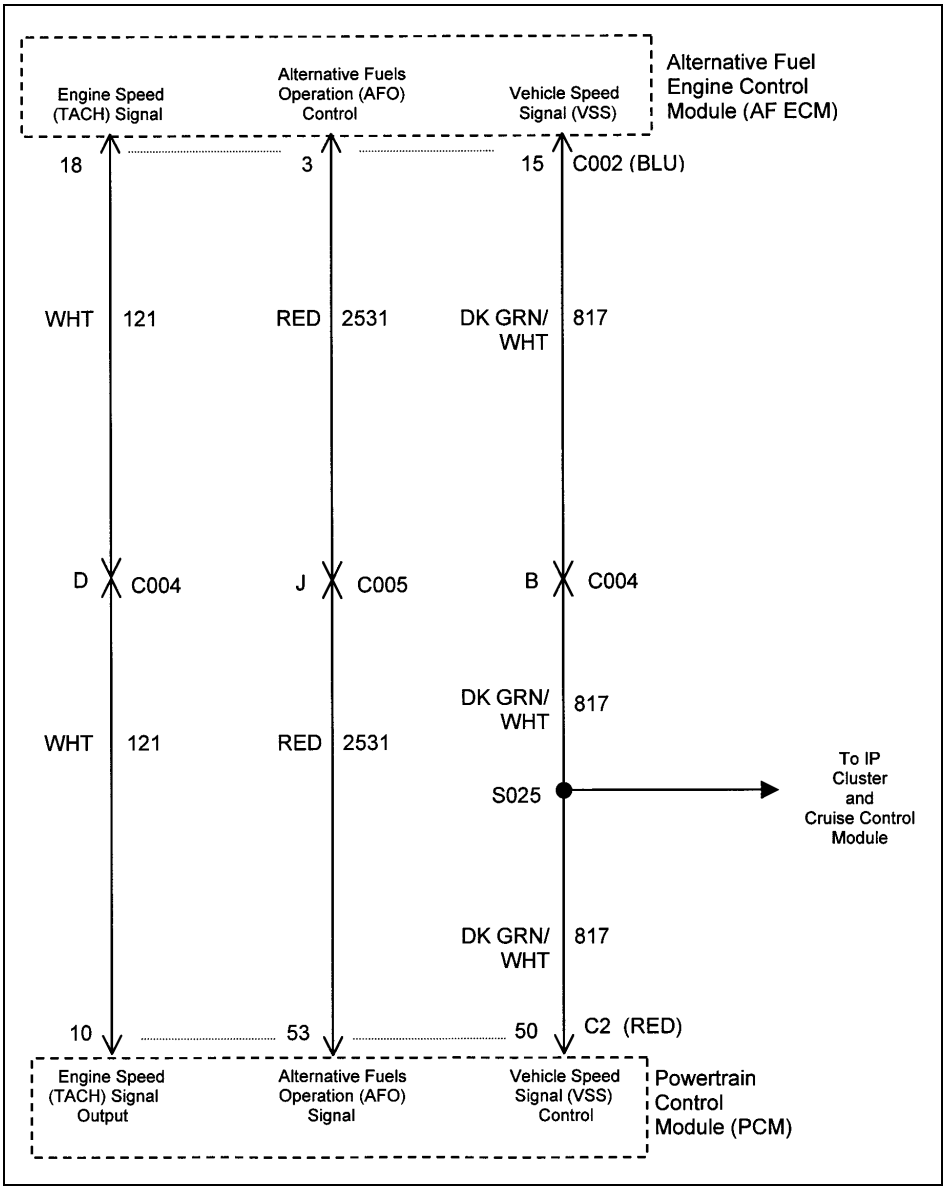
DTC P0336 (DTC 41) CKP Sensor Circuit Performance

Step	Action	Value(s)	Yes	No
1	Was the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Start the vehicle. Does the vehicle start and continue to run?	—	Go to *Diagnostic Aids*	Go to *Step 3*

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Backprobe engine speed signal (TACH) circuit at ECM connector C002. 3. Connect a DVOM set to read AC voltage between the CKP sensor signal circuit and a known good ground. 4. Crank the engine. Is voltage detected while the engine is cranking?	—	Go to *Step 5*	Go to *Step 4*
4	1. Turn OFF the ignition. 2. Disconnect the PCM connector. 3. Disconnect ECM connector C002. 4. Using a DVOM, check for continuity of the CKP sensor signal circuit between the PCM and ECM. Was a problem found?	—	Go to *Step 8*	Go to *Step 6*
5	1. Clear the DTC. 2. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. 3. Check to see if the MIL still illuminates. Did the diagnostic run and pass?	—	Go to *Diagnostic Aids*	Go to *Step 7*
6	1. Check for a short to ground or short to ignition power in the CKP signal circuit. 2. Check for a load on the CKP signal circuit (malfunctioning tachometer). 3. Check for proper pin tension at the PCM connector. Was a problem found and repaired?	—	Go to *Step 10*	Go to *DTC PO336 CKP Sensor Circuit Performance* in the GM G Van Service Manual
7	Inspect the ECM connector and pins. Was a problem found?	—	Go to *Step 8*	Go to *Step 9*
8	Repair the open or damaged circuit. Is the action complete?	—	Go to *Step 10*	—
9	Replace the ECM. Refer to *ECM Replacement.* Is the action complete?	—	Go to *Step 10*	—
10	1. Clear the DTC. 2. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. 3. Check to see if the MIL still illuminates. Did the diagnostic run and pass?	—	Go to *Step 11*	Go to *Step 2*

Step	Action	Value(s)	Yes	No
11	Are any ECM or PCM DTCs stored that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0500 (DTC 24) Vehicle Speed Sensor (VSS) Circuit



Circuit Description

The vehicle speed sensor (VSS) is a magnetic induction sensor. The VSS is mounted close to the output shaft gear in the transmission. The gear teeth induce an alternating current in the sensor as the output shaft rotates. This frequency is applied to the control module at the rate of 40 cycles per output shaft revolution. The control module calculates the vehicle speed using this AC voltage signal.
It the VSS signal is not detected at any vehicle speed for 5 seconds, this diagnostic trouble code will set.
This is a type B DTC.

Conditions for Running the DTC

- No active MAP, MAF or CKP sensor DTCs.
- The MAF is greater than 100 g/s.
- The engine speed is greater than 2500 RPM.

Conditions for Setting the DTC

The AF ECM detects a vehicle speed less than 2 mph MPH for 7 seconds or more.

Action Taken When the DTC Sets

- A first failure of this DTC will illuminate the MIL.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.
- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Thoroughly check the sensor wiring if the complaint is intermittent. An intermittent may be caused by any of the following:

- A poor connection.
- Rubbed through wire insulation.
- A broken wire inside the insulation.

Fault Not Present

Fault Not Present indicates the condition that caused the DTC to set is intermittent and currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

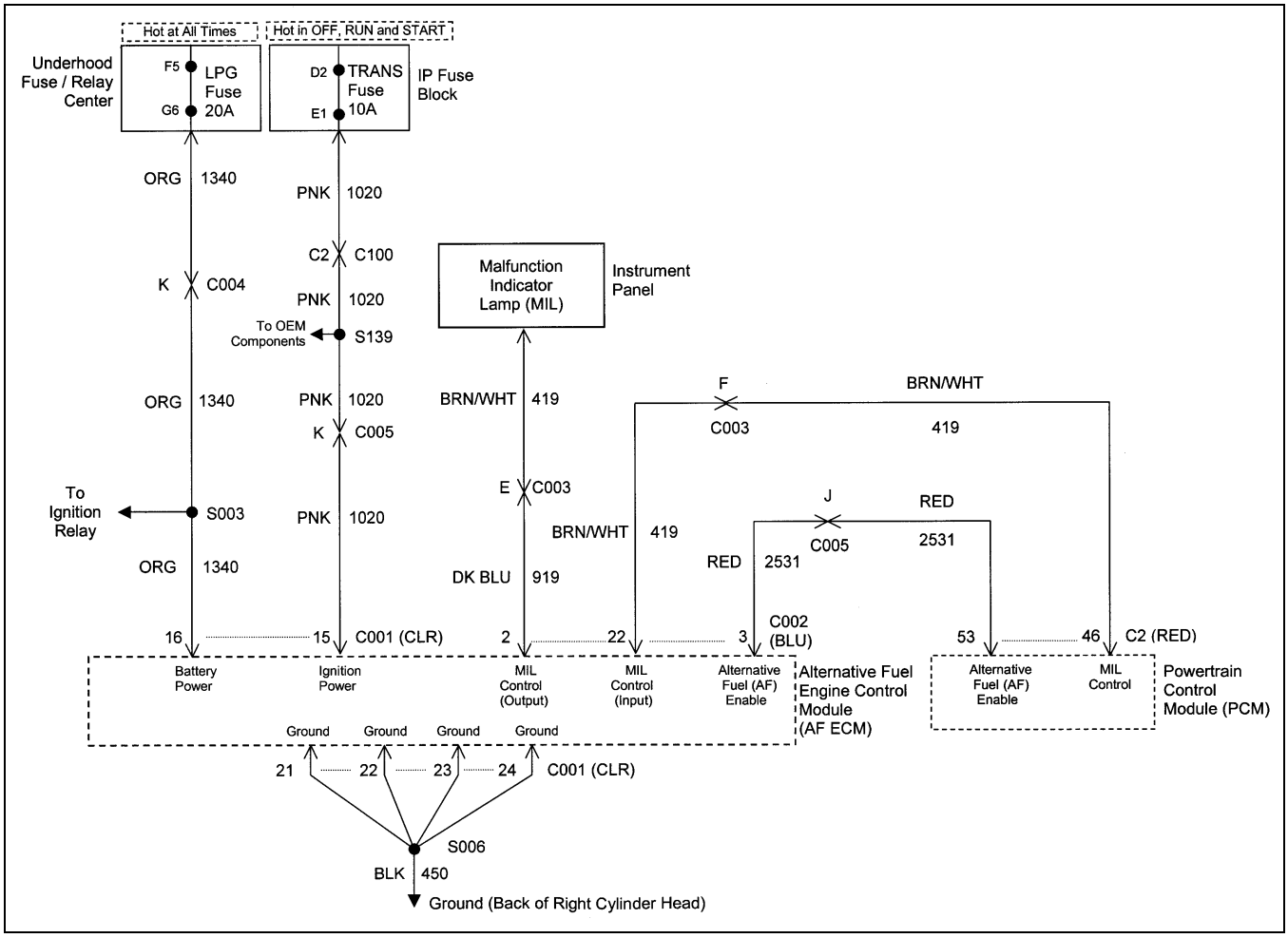
2. This step determines if the DTC P0500 is the result of a hard failure or an intermittent condition.
5. This step checks the wiring, the connections, the PCM and the VSS.

DTC P0500 (DTC 24) Vehicle Speed Sensor (VSS) Circuit

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Connect the scan tool. 2. Clear the AF ECM DTCs. 3. Using a DVOM, backprobe across the VSS signal circuits high and low. 4. Raise the rear wheels of the vehicle. Refer to Lifting and Jacking the Vehicle in General Information in the GM G Van service manual. 5. Operate the engine in gear. 6. Observe the VSS reading on the scan tool. Does the scan tool read the vehicle speed?	—	Go to *Step 3*	Go to *Step 4*
3	The fault is intermittent.	—	Go to *Diagnostic Aids*	—
4	1. Remove the engine from gear. 2. Using a DVOM set to the AC 200V scale, backprobe cavity B of 10-way inline connector C004. 3. Operate the engine in gear. Does the voltage vary with RPM?	—	Go to *Step 6*	Go to *Step 5*

Step	Action	Value(s)	Yes	No
5	1. Remove the engine from gear. 2. Unplug the 10-way inline connector C004. 3. Check the VSS circuit (Pin B) for short to ground or short to power on the AF harness side. Was a problem found?	—	Go to *Step 8*	Go to *Step 10*
6	Backprobe Pin 15 of the AF ECM connector C002. Operate the engine in gear. Does the voltage vary with RPM?	—	Go to *Step 7*	Go to *Step 8*
7	Check for a poor connection Pin 15 of the AF ECM connector C002. Was a problem found and corrected?	—	Go to *Step 11*	Go to *Step 9*
8	Repair the open or short as necessary. Is the action complete?	—	Go to *Step 11*	—
9	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the action complete?	—	Go to *Step 11*	—
10	1. Check the OEM to the VSS circuit splice for an open, short to ground or short to power. 2. Repair the problem as necessary. Was a problem found?	—	Go to *Step 11*	Go to *DTC P0500 VSS Circuit* in the GM G Van service manual
11	4. Using the scan tool, clear the DTC information from BOTH control modules. 5. Operate the vehicle under the Conditions for Running the DTC. 6. Using the scan tool parameter DTC STATUS, ensure that this DTC runs. Did this DTC RUN and PASS?	—	Go to *Step 12*	Go to *Step 2*
12	Using the scan tool, select the Capture Info and the Review Info. Are there any DTCs stored that have not been diagnosed?	—	*Go to the Applicable DTC Table*	System OK

DTC P0601 (DTC 58) AF ECM Internal Failure



Diagnostic Aids

Always diagnose **ANY** PCM codes that are present before beginning this diagnostic procedure.
A poor connection, a rubbed through wire insulation, or a wire broken inside the insulation may cause an intermittent.

Check for the following conditions:

- A poor connection or damaged harness. Inspect the ECM harness connector for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal to wire connection and
  - Damaged harness.

Test Description

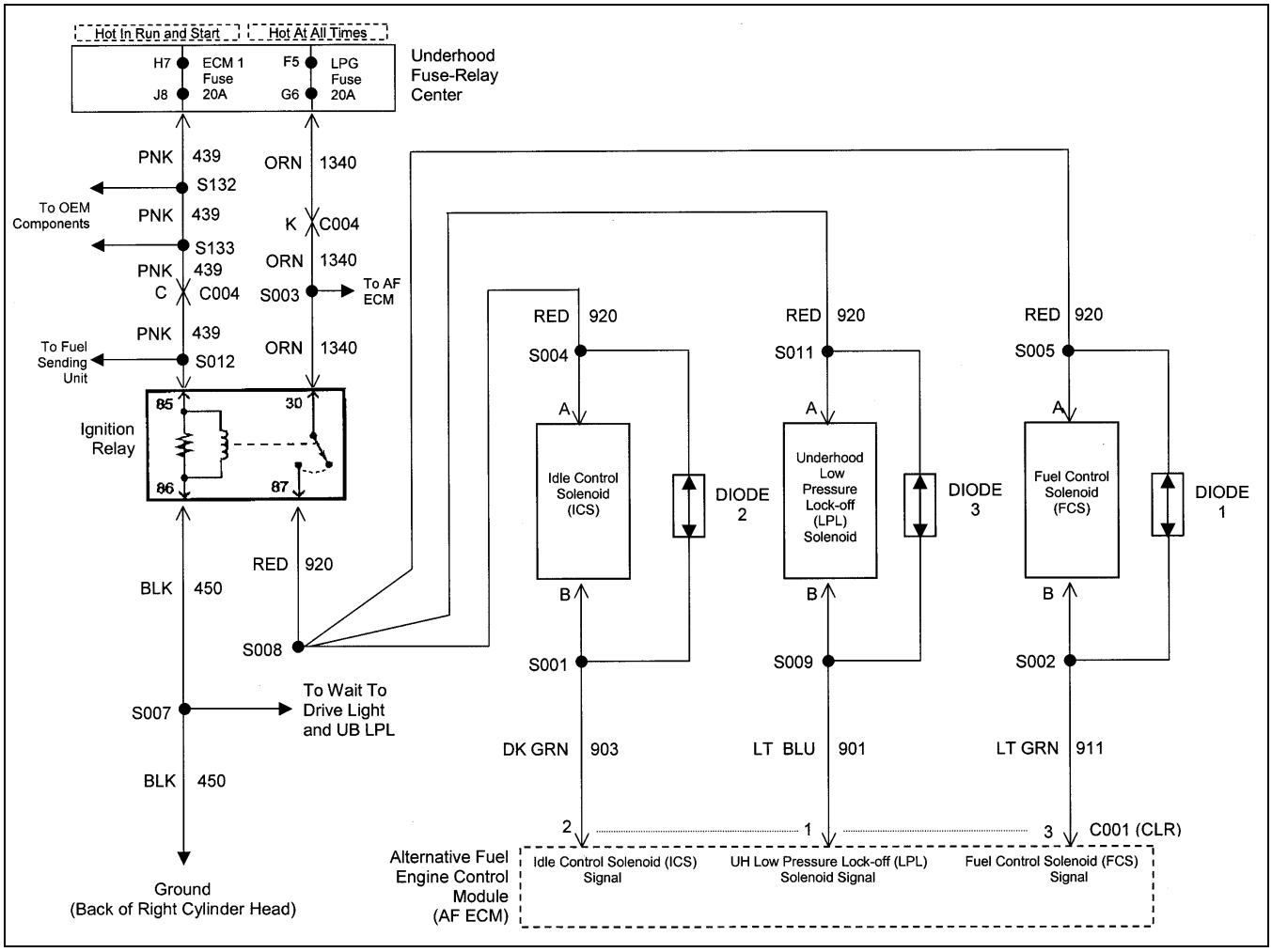
The numbers below refer to the step numbers on the diagnostic table.

3. This step verifies battery power, ignition power and ground to the AF ECM. Intermittent connections may cause the AF ECM to store multiple false codes. If the AF ECM has stored an excessive number of DTCs for no apparent reason, check each of these circuits for an intermittent connection.

DTC P0601 (DTC 58) AF ECM Internal Failure

Step	Action	Value(s)	Yes	No
1	Was the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	Was DTC P0601 (58) retrieved from the AF ECM?	—	Go to *Step 3*	Go to *Step 5*
3	1. Verify that the follow connections to the AF ECM are clean and tight: • Battery Power • Ignition Power • Ground 2. Check loose or corroded connections at the ECM connector. Was a problem found and corrected?	—	Go to *Step 6*	Go to *Step 4*
4	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the replacement complete?	—	Go to *Step 5*	—
5	Were any other DTCs set in the AF ECM?	—	Go to the applicable DTC table	System OK
6	1. Start and run vehicle. 2. Check to see if the MIL still illuminates. Did the diagnostic run and pass?	—	Go to *Step 7*	Go to *Step 2*
7	Are any ECM or PCM DTCs stored that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1215 (DTC 27) Control Module Output Circuits



Circuit Description
The AF ECM contains electronic devices called output driver modules. The output driver modules provide switchable outputs (control circuits) for operating solenoids, telltales and other devices. Each of the outputs has an internal fault line that the AF ECM can monitor for faulted circuit conditions.

This DTC is used to indicate that the AF ECM fault line has monitored a control circuit fault.

Monitored control circuits include the following:
- The AF Enable Output control circuit
- The underhood low pressure lock-off (LPL)
- The fuel solenoid control (FCS)
- The idle control solenoid (ICS)

This is a type A DTC.

Conditions for Running the DTC
The ignition is ON.

Conditions of Setting the DTC
The AF ECM monitors a control circuit fault for at least one second continuously

Action Taken When the DTC Sets
- The AF ECM will illuminate the MIL and store the DTC as History during ONE drive trip that the diagnostic runs and fails.
- The AF ECM will record operating conditions at the time the DTC sets. This information will be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC
- The Last Test Failed status will clear when the DTC runs and passes.
- The AF ECM will turn OFF the MIL after THREE consecutive drive trips that the DTC runs and passes.
- The History status will clear after FORTY consecutive WARM-UP cycles with NO failures of ANY DTC.
- All information can be cleared using a scan tool.

- Interruption of Control Module (AF ECM / PCM) power and ground MAY clear DTC information. Clearing DTC information with this method is inconsistent and should not be performed.

Diagnostic Aids

Fault Not Present
Fault Not Present indicates the condition that caused the DTC to set is intermittent and not currently present. Refer to *Intermittents* in Symptom diagnosis for additional information. If any additional DTCs were stored, proceed to the applicable DTC table in the order stated in the OBD System Check.

Preliminary Checks
Check for the following conditions:

- A poor connection, a rubbed through wire insulation, or a wire that is broken inside the insulation may cause an intermittent problem.
- Inspect harness connectors for the following conditions:
  - Backed out terminals.
  - Improper mating.
  - Broken locks.
  - Improperly formed or damaged terminals.
  - Poor terminal to wire connection.
- - Physical damage to the wiring harness.

DTC P1215 (DTC 27) Control Module Output Circuits

Step	Action	Value(s)	Yes	No
1	Did you perform the Alternative Fuels (AF) Powertrain On-Board Diagnostic (OBD) System Check?	—	Go to *Step 2*	Go to *AF Powertrain OBD System Check*
2	1. Using the scan tool, establish communication with the AF ECM and clear DTC information. 2. Crank the engine. 3. Observe the DTC status. Did the DTC reset?	—	Go to *Step 3*	Go to *Intermittents*
3	Using the scan tool, observe the AF ECM output driver data display with the engine cranking or running. Does the AFO enable show a circuit fault?	—	Go to *Step 10*	Go to *Step 4*
4	Using the scan tool, observe the AF ECM output driver data display with the engine cranking or running. Does the low pressure lock-off (LPL) show a circuit fault?	—	Go to *Step 7*	Go to *Step 5*
5	Does the fuel control solenoid (FCS) show a circuit fault?		Go to *Step 8*	Go to *Step 6*
6	Does the idle control solenoid (ICS) show a circuit fault?		Go to *Step 9*	Go to *Intermittents*
7	Check the AF ECM to underhood LPL ground circuit for an open, short to ground or short to power. Refer to *Engine Controls Schematics.* Was a problem found?	—	Go to *Step 16*	Go to *Step 11*

Step	Action	Value(s)	Yes	No
8	Check the AF ECM to FCS ground circuit for an open, short to ground or short to power. Refer to *Engine Controls Schematics.* Was a problem found?	—	Go to *Step 16*	Go to *Step 12*
9	Check the AF ECM to ICS ground circuit for an open, short to ground or short to power. Refer to *Engine Controls Schematics.* Was a problem found?	—	Go to *Step 16*	Go to *Step 13*
10	Check the AFO enable circuit from AF ECM to PCM for an open, short to ground or short to power. Refer to *Engine Controls Schematics.* Was a problem found?	—	Go to *Step 16*	Go to *Step 17*
11	Disconnect the LPL electrical connector. Measure the resistance of the LPL. Was the resistance within specification?	12Ω-16Ω	Go to *Step 14*	Go to *Step 15*
12	Disconnect the FCS electrical connector. Measure the resistance of the FCS. Was the resistance within specification?	17Ω-24Ω	Go to *Step 14*	Go to *Step 15*
13	Disconnect the ICS electrical connector. Measure the resistance of the ICS. Was the resistance within specification?	17Ω-24Ω	Go to *Step 14*	Go to *Step 15*
14	Check AF ECM connectors C001 and C002 for damaged pins or bad connections. Was a problem found?		Go to *Step 16*	Go to *Step 17*
15	Replace the component. Is the action complete?	—	Go to *Step 18*	—
16	Repair the circuit as necessary. Is the action complete?	—	Go to *Step 18*	—
17	Replace the AF ECM. Refer to *AF ECM Replacement.* Is the action complete?	—	Go to *Step 18*	—
18	1. Clear the DTC. 2. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. 3. Check to see if the MIL still illuminates. Did the diagnostic run and pass?	—	System OK	Go to *Step 2*

Symptom Diagnosis

Important Preliminary Checks

Checks	Action
Before Using This Section	Before using this section, you should have performed AF Powertrain On Board Diagnostic Check and determined that: 1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.
LPG Fuel System Check	1. Verify the customer complaint. 2. Locate the correct symptom table. 3. Check the items indicated under that symptom. 4. Operate the vehicle under the conditions the symptom occurs. Verify HO2S switching between lean and rich. **IMPORTANT!** **Normal HO2S switching indicates the LPG fuel system is in closed loop and operating correctly at that time.** 5. If a scan tool is available, **take a snapshot** under the condition that the symptom occurs. Go to *AF Engine Scan Tool Data* List to verify normal sensor values and parameters.
Visual and Physical Checks	• Check all ECM and PCM system fuses and circuit breakers. • Check the ECM and PCM grounds for being clean, tight and in their proper location. • Check the vacuum hoses for splits, kinks and proper connections, as shown on the Vehicle Emission Control Information Label. • Check thoroughly for any type of leak or restriction. • Check for air leaks at all the mounting areas of the intake manifold sealing surfaces. • Check for proper installation of the mixer module assembly. • Check for air leaks at the mixer assembly. • Check the ignition wires for the following conditions: – Cracking – Hardness – Proper routing – Carbon tracking • Check the wiring for the following items: – Proper connections, pinches or cuts. • The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. To determine if a specific vehicle is using a particular system or component, refer to the Control Module Wiring Diagrams in the GM G Van Service Manual for an application.

Intermittents

Checks	Action
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	• Faulty electrical connections or wiring can cause most intermittent problems. • Check the suspected circuit for the following conditions: – Faulty fuse or circuit breaker – Connectors poorly mated – Terminals not fully seated in the connector (backed out) – Terminals not properly formed or damaged – Terminal to wires poorly connected – Terminal tension insufficient. • Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension. If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension. • Checking for poor terminal to wire connections requires removing the terminal from the connector body in.
Road Test	If a visual and physical check does not locate the cause of the problem, drive the vehicle with a *J 39200* connected to a suspected circuit or use a scan tool. When the problem occurs, an abnormal voltage or scan reading indicates the problem may be in that circuit.
Intermittent Malfunction Indicator Lamp (MIL)	The following components can cause intermittent MIL and no DTC(s): • A defective relay, Control Module driven solenoid, or a switch that can cause an electrical system interference. Normally, the problem will occur when the faulty component is operating. • The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc. • The ignition secondary voltage shorted to a ground. • The Malfunction Indicator Lamp (MIL) circuit or the Diagnostic Test Terminal intermittently shorted to ground. • The Control Module grounds.
Loss of DTC Memory	1. In order to check for the loss of the DTC Memory, disconnect the MAF sensor. 2. Idle the engine until the Malfunction Indicator Lamp illuminates. 3. The PCM and should store a MAF DTC. 4. The MAF DTC should remain in the memory when turning off the ignition. 5. If the MAF IAT DTC does not store and remain, the PCM is faulty. 6. The ECM memory may be checked in the same manner by selecting a DTC and intentionally setting the fault
Additional Checks	Check for an open diode across the A/C compressor clutch and for other open diodes.

No Start

Checks	Action
DEFINITION: The engine cranks OK but does not start.	
Preliminary Checks	• Refer to *Important Preliminary Checks.*

Control Module Checks	• If a scan tool is available:
	  • Check for proper communication with both the PCM and the AF ECM.
	  • Verify the correct LPG specific PCM software is installed.
	  • Check the AF enable circuit from the AF ECM.
	• Check the 20A CNG, ECM 1 and ECM B fuses in the underhood fuse / relay center. Refer to *Engine Controls Schematics.*
	• Check the 10A TRANS fuse in the IP fuse block. Refer to *Engine Controls Schematics.*
	• Check the fuel pump relay in the underhood fuse / relay center. Refer to *Engine Controls Schematics.*
	• Check battery power, ignition power and ground circuits to the AF ECM. Refer to *Engine Control Schematics.* Verify voltage and/or continuity for each circuit.
	• Check battery power, ignition power and ground circuits to the PCM. Refer to *Engine Control Schematics* in the GM G Van service manual. Verify voltage and/or continuity for each circuit.

Sensor Checks	• Check the Crankshaft Position (CKP) sensor. • Check the Camshaft Position (CMP) sensor. • Check the Mass Air Flow (MAF) sensor.
Fuel System Checks	**Important**: A closed LPG manual fuel shut off override valve will create a no start condition. • Check for air intake system leakage between the mixer and the throttle body. • Check the fuel pump relay for proper operation. The fuel pump relay circuit supplies a voltage signal to the fuel tank lock-off solenoid. Refer to *Fuel Pump Circuit Diagnosis* in the GM G Van Service Manual. • Verify proper operation of the low pressure lock-off solenoid. • Verify proper operation of the fuel tank lock-off solenoid. • Verify proper operation of the fuel control solenoid. • Verify proper operation of the idle control solenoid. • Check the fuel system pressures. Refer to the *AF Fuel System Diagnosis*. • Check the coolant level. If coolant is added, bleed the cooling system using the Schrader valve on the LPR. • Check for proper mixer air valve operation.

Checks	Action
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. • Check for the proper ignition voltage output with *J 26792* or the equivalent. • Verify that the spark plugs are correct. • Check the spark plugs for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for bare or shorted ignition wires. • Check for loose ignition coil connections at each coil.
Engine Mechanical Checks	**Important:** The AF system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. • Check for the following: – Vacuum leaks – Improper valve timing – Low compression – Bent pushrods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes.
Exhaust System Checks	• Check the exhaust system for a possible restriction: – Inspect the exhaust system for damaged or collapsed pipes – Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter. Refer to *Restricted Exhaust System Diagnosis* or *Exhaust System* in the GM G Van Service Manual.

Hard Start

Checks	Action
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	• Check the Engine Coolant Temperature (ECT) sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. IF the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to *DTC P0118 ECT Sensor Circuit High Voltage* or *DTC P1115 ECT Sensor CKT Intermittent High Voltage* in the GM G Van Service Manual. • Check the Crankshaft Position (CKP) sensor. • Check the Mass Air Flow (MAF) sensor.
Fuel System Checks	**Important**: A closed LPG manual fuel shut off override valve will create an extended crank OR no start condition. • Verify the excess flow valve in the fuel tank lock-off valve is not tripped. • Check the fuel pump relay for proper operation. The fuel pump relay circuit supplies a voltage signal to the fuel tank lock-off lock-off (LPL) solenoids. Refer to *Fuel Pump Circuit Diagnosis* in the GM G Van Service Manual. • Check mixer module assembly for proper installation and leakage. • Verify proper operation of the low pressure lock-off solenoid. • Verify proper operation of the fuel tank lock-off solenoid. • Verify proper operation of the fuel control solenoid. • Verify proper operation of the idle control solenoids. • Check for air intake system leakage between the mixer and the throttle body. • Check the coolant level. If coolant is added, bleed the cooling system using the Schrader valve on the LPR. • Check the fuel system pressures. Refer to the *AF Fuel System Diagnosis*.

Checks	Action
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. • Check for the proper ignition voltage output with *J 26792* or the equivalent. • Verify that the spark plugs are correct. • Check the spark plugs for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for bare or shorted ignition wires. • Check for moisture in the distributor cap if applicable. • Check for loose ignition coil connections. **Important**: 1. If the engine starts but then immediately stalls, remove the (CKP) sensor. 2. Check for improper resistance or faulty connections. 3. Check the Crankshaft Position (CKP) sensor resistance and connections. Refer to *Enhanced Ignition System* in the GM G Van Service Manual.
Engine Mechanical Checks	**Important:** The AF system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. • Check for the following: – Vacuum leaks – Improper valve timing – Low compression – Bent pushrods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes. Ref • Check the intake and exhaust manifolds for casting flash.
Exhaust System Checks	• Check the exhaust system for a possible restriction: – Inspect the exhaust system for damaged or collapsed pipes – Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter. Refer to *Restricted Exhaust System Diagnosis* or *Exhaust System* in the GM G Van Service Manual.
Additional Checks	• Verify the correct LPG specific PCM software is installed.

Cuts Out, Misses

Checks	Action
DEFINITION: A surging or jerking that follows engine speed, usually more pronounced as the engine load increases which is not normally felt above 1500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Checks	• Refer to *Important Preliminary Checks*.

Ignition System Checks	• Start the engine.
	• Wet down the secondary ignition system with water from a spray bottle, and look/listen for arcing or misfiring as you apply water.
	• Check for proper ignition output voltage with spark tester J 26792.
	• Check for a cylinder misfire.
	• Verify that the spark plugs are correct.
	• Remove the spark plugs in these cylinders and check for the following conditions:
	  • Insulation cracks
	  • Wear
	  • Improper gap
	  • Burned electrodes
	  • Heavy deposits
	  • Visually/Physically inspect the secondary ignition for the following:
	  • Ignition wires for arcing, cross-firing and proper routing
	  • Ignition coils for cracks or carbon tracking

Engine Mechanical Checks	• Perform a cylinder compression check.
	• Check the engine for the following:
	  – Improper valve timing
	  – Bent pushrods
	  – Worn rocker arms
	  – Worn camshaft lobes.
	  – Broken or weak valve springs.
	• Check the intake and exhaust manifold passages for casting flash.

Fuel System Checks	• Check the fuel system - plugged fuel filter, low fuel pressure, etc. Refer to *AF Fuel System Diagnosis*. • Check the condition of the wiring to the low pressure lock-off solenoid.
Additional Check	Check for Electromagnetic Interference (EMI). • EMI on the reference circuit can cause a missing condition. • Monitoring the engine RPM with a scan tool can detect an EMI. • A sudden increase in the RPM with little change in the actual engine RPM, indicates EMI is present. • If the problem exists, check the routing of the secondary wires and the ground circuit.

Hesitation, Sag, Stumble

Checks	Action
DEFINITION: The vehicle has a momentary lack of response when depressing the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move, as from a stop sign. The condition may cause the engine to stall if it's severe enough.	
Preliminary Checks	Refer to *Important Preliminary Checks*.
Fuel System Checks	• Check the fuel pressure. Refer to *AF Fuel System Diagnosis*. • Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system. • Check the Manifold Absolute Pressure (MAP) sensor response and accuracy. • Check the mixer air valve for sticking or binding. • Check the mixer module assembly for proper installation and leakage. • Check the FCS / ICS connections.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly. • Check for the proper ignition voltage output with *J 26792* or the equivalent. • Verify that the spark plugs are correct. • Check for faulty spark plug wires • Check for fouled spark plugs. • Check for an open ignition system ground. Refer *to Enhanced Ignition System* in the GM G Van Service Manual.
Additional Check	• Check for Service Bulletins. • Check for manifold vacuum or air induction system leaks • Check the generator output voltage. • Check the EGR valve operation. Refer to *EGR System Diagnosis* in the GM G Van Service Manual.

Backfire

Checks	Action
DEFINITION: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary Check	• Refer to *Important Preliminary Checks.*
Ignition System Checks	**Important!** **LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.** • Check for the proper ignition coil output voltage using the spark tester *J26792* or the equivalent. • Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 5,000 ohms, replace the wires. **Note**: The vehicle may be equipped with low resistance plug wires, refer to G Van service manual for proper plug wire resistance. • Check the connection at each ignition coil. • Check for deteriorated spark plug wire insulation. • Verify that the correct spark plugs are correct. • Remove the plugs and inspect them for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check the ignition system. Refer to *Ignition System Diagnosis* in the GM G Van Service Manual.
Engine Mechanical Check	**Important!** **The AF system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than a gasoline fuel supply system.** • Check the engine for the following: – Improper valve timing – Engine compression – Manifold vacuum leaks – Intake manifold gaskets – Sticking or leaking valves – Exhaust system leakage • Check the EGR operation for being open all the time. Refer to *EGR System Diagnosis* in the GM G Van Service Manual. • Check the intake and exhaust system for casting flash or other restrictions.

Fuel System Checks	• Perform a fuel system diagnosis. Refer to *AF Fuel System Diagnosis*.
Additional Checks	• Proper PCM software calibrations • Check the EGR gasket for a faulty or loose fit. • Check the EGR valve operation for being open all the time. Refer to *EGR System Diagnosis* in the GM G Van Service Manual.

Lack of Power, Sluggishness, or Sponginess

Checks	Action
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Refer to the *Alternative Fuel (AF) Powertrain OBD System Check* • Search for service bulletins. • Compare the customer's vehicle with a similar unit. Make sure the customer has an actual problem. *Do not compare the power output of the vehicle operating on LPG to a vehicle operating gasoline as the fuels do have different drive feel characteristics* • Remove the air filter and check for dirt or restriction. • Check the transmission shift pattern and the downshift operation.
Fuel System Checks	• Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to *AF Fuel System Diagnosis*. • Check for the proper ignition output voltage with the spark tester *J 26792* or the equivalent. • Check for proper installation of the mixer module assembly. • Check all air inlet ducts for condition and proper installation. • Check for fuel leaks between the LPR and the mixer. • Verify that the LPG tank manual shut-off valve is fully open. • Verify that liquid fuel (not vapor) is being delivered to the LPR.
Sensor Checks	• Check the Heated Oxygen Sensor (HO2S) for contamination and performance. Refer to *Heated Oxygen Sensor* in the GM G Van Service Manual. • Check for proper operation of the MAP sensor. • Check for proper operation of the ECT sensor. • Check EGR system for proper operation.
Exhaust System Checks	• Check the exhaust system for a possible restriction: – Inspect the exhaust system for damaged or collapsed pipes – Inspect the muffler for signs of heat distress or for possible internal failure. – Check for possible plugged catalytic converter. Refer to *Restricted Exhaust System Diagnosis* or *Exhaust System* in the GM G Van Service Manual.
Engine Mechanical Check	Check the engine for the following: • Engine compression • Valve timing • Improper or worn camshaft. Refer to *Engine Mechanical* in the GM G Van Service Manual.

Checks	Action
Additional Check	• Check the Control Module grounds for being clean, tight, and in their proper locations. • Check for an Intermittent EGR problem. Refer to *EGR System Diagnosis* in the GM G Van Service Manual. • Check the A/C operation. Refer to *A/C Compressor Clutch Control Diagnosis* in the GM G Van Service Manual. • Check for proper Torque Converter Clutch (TCC) operation. • Check the generator output voltage. • If all procedures have been completed and no malfunction has been found, review and inspect the following items: • Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. • Check the scan tool data.

Poor Fuel Economy

Checks	Action
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary Checks	• Refer to *Important Preliminary Checks*. • Check the air cleaner element (filter) for dirt or being plugged. • Visually (Physically) check the vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Control Label. • Check the owner's driving habits for the following items: – Is the A/C ON full time (Defroster mode ON)? – Is there excessive idling or stop and go driving? – Are the tires at the correct air pressure? – Are excessively heavy loads being carried? – Is their often rapid acceleration? • Suggest to the owner to fill the fuel tank and to recheck the fuel economy. • Suggest to the driver to refer to Important Facts on Fuel Economy in the GM G Van Owner's Manual.
Fuel System Checks	• Check the LPR fuel pressure. Refer to *AF Fuel System Diagnosis*. • Check the fuel system for leakage
Sensor Checks	• Check the Engine Coolant Temperature (ECT) sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to *DTC P0118 ECT Sensor Circuit High Voltage* or *DTC P1115 ECT Sensor CKT Intermittent High Voltage* in the GM G Van Service Manual. • Check the Mass Air Flow (MAF) sensor.
Ignition System Checks	• Verify that the spark plugs are correct. • Check the spark plugs. Remove the plugs and inspect them for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check the ignition wires for the following items: – Cracking – Hardness – Proper connections
Cooling System Checks	• Check the coolant level. If coolant is added, bleed the cooling system using the Schrader valve on the LPR. • Check the engine thermostat for always being open or for the wrong heat range. Refer to *Thermostat Diagnosis* in Engine Cooling in the GM G Van Service Manual.

Checks	Action
Additional Check	• Check the transmission shift pattern. Refer to the Transmission Controls section in the GM G Van Service Manual. • Check for Torque Converter Clutch (TCC) operation. Refer *to Torque Converter Clutch Solenoid* in Automatic Transmission in the GM G Van Service Manual. • Check for proper calibration of the speedometer. • Check for dragging brakes.

Rough, Unstable, or Incorrect Idle, Stalling

Checks	Action
DEFINITION: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Check	• Refer to *Important Preliminary Checks*.
Sensor Checks	• Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage (rich exhaust indication). The Control Module will reduce the amount of fuel delivered to the engine causing a severe driveability problem. • Check the (Heated) Oxygen Sensor (HO2S) performance: • Check the Engine Coolant Temperature (ECT) sensor using the scan tool to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5° greater than or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or the sensor itself. Refer to *DTC P1115 ECT Sensor CKT Intermittent High Voltage* Diagnostic Aids or *DTC P0118 ECT Sensor Circuit High Voltage* Diagnostic Aids in the GM G Van Service Manual. • Check the Manifold Absolute Pressure (MAP) sensor response and accuracy.
Fuel System Checks	• Check for rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. • Check the coolant level. If coolant is added, bleed the cooling system using the Schrader valve on the LPR. • Check for a sticking or dirty mixer air valve. • Verify proper operation of the idle control solenoid. • Verify proper operation of the fuel control solenoid. • Perform a cylinder compression test. Refer to *Engine Mechanical* in the GM G Van Service Manual. • Check for leaking fuel injectors. While the injectors are not used, they provide a possible vacuum leak point. • Verify that the injector fuel rail plugs are in place. • Check the LPR fuel pressure. Refer to the *AF Fuel System Diagnosis*. • Check mixer module assembly for proper installation and connection.

Checks	Action
Ignition System Checks	• Check for the proper ignition output voltage using the spark tester *J26792* or the equivalent. Refer to *Ignition System Diagnosis* in the GM G Van Service Manual. • Verify that the spark plugs are correct. • Check the spark plugs. Remove the plugs and inspect them for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Blistered insulators – Heavy deposits • Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 5,000 ohms, replace the wires. **Note**: The vehicle may be equipped with low resistance plug wires, refer to G Van Service Manual for proper plug wire resistance.
Additional Checks	**Important:** The AF system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. • Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command. • Check the Control Module grounds for being clean, tight, and in their proper locations. • Check the Automatic Transmission Fluid Pressure (TPF) manual valve indicator. Refer to Transmission Fluid Pressure Switch Assembly. • Check the scan tool to determine if the Control Module is receiving an A/C signal. Refer to *A/C Compressor Clutch Control* in the GM G Van Service Manual. If a problem exists with the A/C ON, check the A/C system operation. • Check for EGR being ON while idling that will cause roughness, stalling, and hard starting. Refer to *EGR System Diagnosis* in the GM G Van Service Manual. • Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality. • Check the A/C refrigerant pressure for being too high or for a faulty high pressure switch.
Engine Mechanical Check	• Check the engine for the following: – Broken motor mounts – Improper valve timing – Low compression – Bent pushrods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes

Surges/Chuggles

Checks	Action
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Be sure the driver understands the Torque Converter Clutch operation. • Be sure the driver understands the A/C Compressor operation. • Use the scan tool to make sure the reading of the Vehicle Speed Sensor (VSS) matches the vehicle speedometer. This excludes vehicles with electronic transmissions where some variation between the VSS and the speedometer is normal.
Sensor Checks	Check the (Heated) Oxygen Sensor (HO2S) performance.
Fuel System Checks	• Check for Rich or Lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. • Check the coolant level. If coolant is added, bleed the cooling system using the Schrader valve on the LPR. • Check the fuel pressure while the condition exists. Refer to *AF Fuel System Diagnosis.* • Verify proper fuel control solenoid operation. • Verify that the LPG manual shut-off valve is fully open. • Check the in-line fuel filter for restrictions.
Ignition System Checks	• Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. Refer to *Enhanced Ignition System* in the GM G Van Service Manual. • Verify that the spark plugs are correct. • Check the spark plugs. Remove the plugs and inspect them for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits Check the Crankshaft Position (CKP) sensor. Refer to *DTC P0336 CKP Sensor Circuit Performance* in the GM G Van Service Manual.
Additional Check	• Check the Control Module grounds for being clean, tight, and in their proper locations. • Check the generator output voltage. • Check the vacuum hoses for kinks or leaks. Refer to the Vehicle Emission Control Information label on the top of the radiator. • Check for an Intermittent EGR problem. Refer to *EGR System Diagnosis* in the GM G Van Service Manual. • Check for Torque Converter Clutch (TCC) operation.

REPAIR INSTRUCTIONS

PROPANE FUEL SYSTEM PRESSURE RELIEF

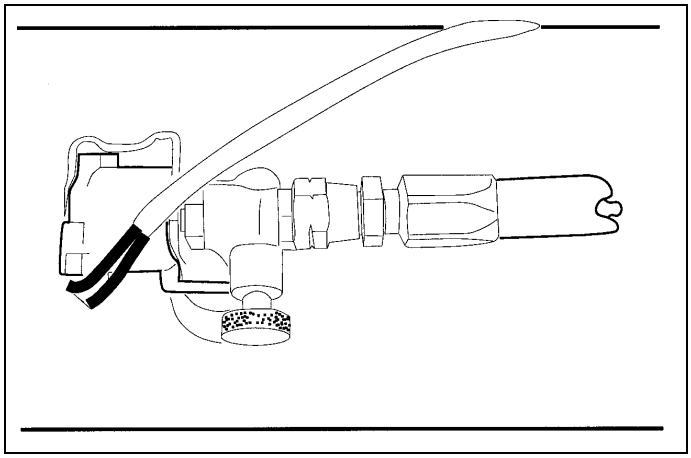
CAUTION: The propane fuel system operates at pressures up to 312 psi. To minimize the risk of fire and personal injury, relieve the propane fuel system pressure (where applicable) before servicing the propane fuel system components.

CAUTION: After relieving propane fuel system pressure, a small amount residual pressure will be present. Ensure the work area is well ventilated before disconnecting any fuel line

Using GM Tech 2

1. Connect a GM Tech 2.
2. Start the vehicle.
3. From the PCM Device Controls menu for the L31 V8, command the gasoline fuel pump relay OFF / CLOSED.
4. Run the engine until it stalls.

Using Manual Shut-off Valve



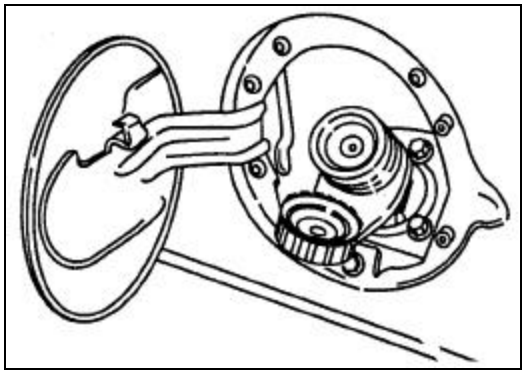
1. Close the manual shut-off (thumb wheel) on the fuel tank lock-off solenoid.
2. Start and run the engine until it stalls.

PROPANE FUEL SYSTEM LEAK TEST

CAUTION: Never use an open flame of any type to check for propane fuel system leaks.

Always inspect the propane fuel system for leaks after performing service. Check for leaks at the fittings of the serviced or replaced component. Use a commercially available liquid leak detector or an electronic leak detector. When using both methods, use the electronic leak detector first to avoid contamination by the liquid leak detector.

PROPANE FILL VALVE REPLACEMENT



Removal Procedure

1. Disconnect the negative battery cable.
2. Slowly open the fuel line fitting at the fill valve to relieve the fuel pressure.
3. Disconnect the fuel line from the fill valve.
4. Remove the fill valve cover.
5. Remove the fill valve mounting nut and the fill valve.

Installation Procedure

1. Install the fill valve and the mounting nut.
   - Tighten the nut to 54 N•m (40 lb-ft).
2. Install the fill valve cover.
3. Connect the fuel fill line to fill valve.
   - Tighten the fitting to 47 N•m (35 lb-ft).
4. Connect the negative battery cable.

FUEL LINE (FILL VALVE TO TANK) REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel tank cover bolts and the cover.
3. Slowly open the fuel line fitting at the fill valve to relieve the pressure.
4. Remove any clips, clamps or brackets from the fuel line.
5. Disconnect the fuel line at the fill valve.
6. Disconnect the fuel line at the tank.
7. Remove the fuel line.

Installation Procedure

1. Install the fuel line.
2. Connect the fuel fill line at the tank.
   - Tighten the fitting to 47 N•m (35 lb-ft).
3. Connect the fuel fill line to the fill valve.
   - Tighten the fitting to 47 N•m (35 lb-ft).

4. Install any clips, clamps to brackets to the fuel line.
5. Connect the negative battery cable.
6. Start the vehicle and leak check the propane fuel system at each serviced fitting.
7. Install the fuel tank cover and bolts.
   - Tighten the bolts to 22 N•m (16 lb-ft).

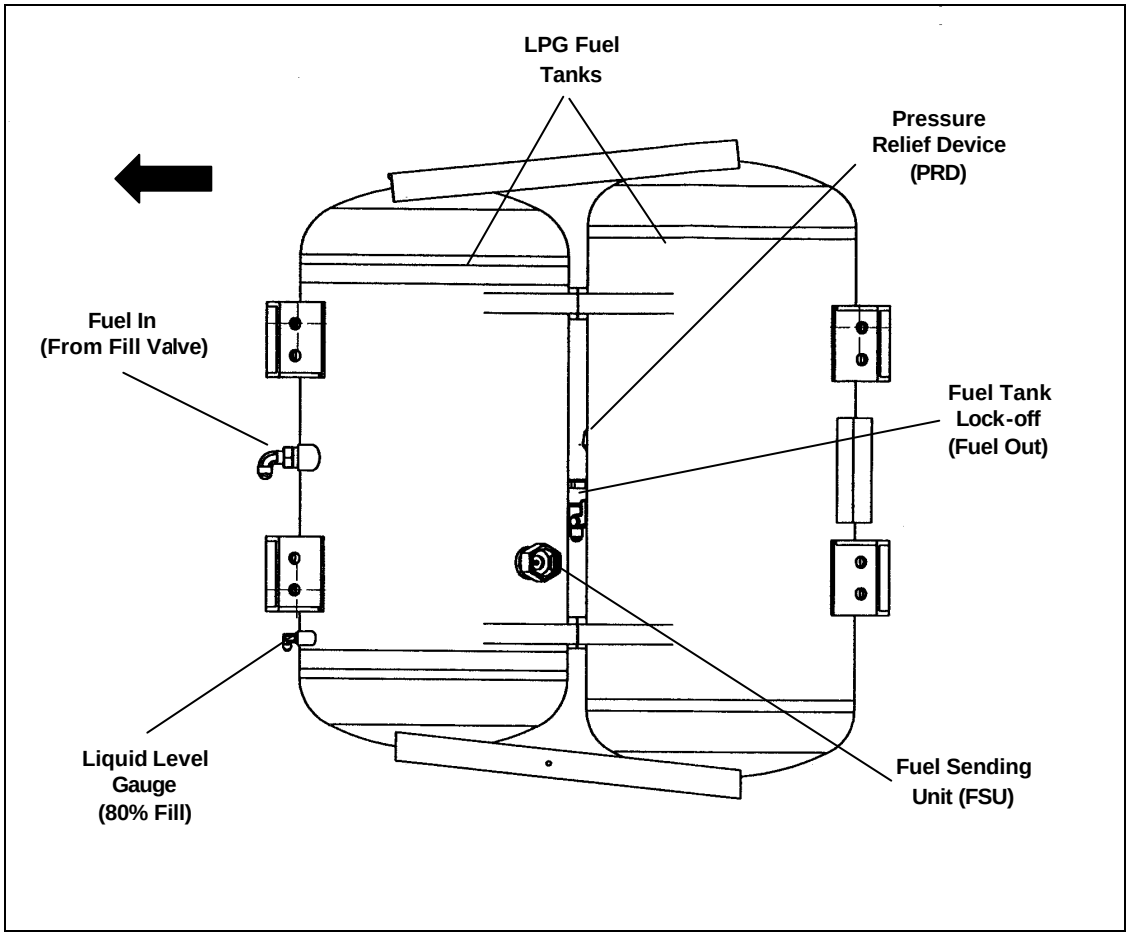
PROPANE FUEL TANK COVER REPLACEMENT

Removal Procedure

1. Remove the propane fuel tank cover mounting bolts and the cover.

Installation Procedure

1. Install the propane fuel tank cover and the mounting bolts.
   - Tighten the bolts to 22 N•m (16 ft-lb).


LPG Fuel Tanks
Pressure Relief Device (PRD)
Fuel In (From Fill Valve)
Fuel Tank Lock-off (Fuel Out)
Liquid Level Gauge (80% Fill)
Fuel Sending Unit (FSU)

PROPANE FUEL TANK REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer *to Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the fuel tank cover mounting bolts and cover.
4. Disconnect the following electrical connectors:
   - Fuel sending unit (FSU).
   - Fuel tank lock-off.
5. Disconnect the following fuel lines from the tank:
   - Fuel out (at fuel tank lock-off).
   - Fuel in (from fill valve).
   - Liquid level gauge.
6. Position a suitable tank support / lifting device under the tank. Secure the tank to the device.
7. Remove the tank to bracket nuts and bolts.
8. Remove the tank from the vehicle.
9. If the tank is being replaced, drain the tank. Refer to *Propane Fuel Tank Draining.*

Installation Procedure

1. Using a suitable tank support / lifting device, raise and position the tank under the vehicle.
2. Install the tank bracket nuts and bolts.
   - Tighten the nuts and bolts to 105 N•m (77 lb-ft).
3. Verify the tank and bracket is secure. Remove the tank lifting / support device.
4. Connect the following fuel lines to the tank:
   - Liquid level gauge. Tighten to 16 N•m (12 lb-ft).
   - Fuel in (from fill valve). Tighten to 47 N•m (35 lb-ft).
   - Fuel out (at fuel tank lock-off). Tighten to 37 N•m (27 lb-ft).
5. Connect the following electrical connectors.
   - Fuel tank lock-off.
   - Fuel sending unit (FSU).
6. Connect the negative battery cable.
7. Start the vehicle and leak check the propane fuel system at each serviced fitting.
8. Install the fuel tank cover and mounting bolts.
   - Tighten the bolts to 22 N•m (16 lb-ft).

PROPANE FUEL TANK DRAINING

CAUTION: To prevent the risk of fire and personal injury, do not attempt to drain a propane fuel tank. You or someone else could be injured. Draining a propane fuel tank requires trained personnel and special equipment. Contact a local propane distributor to drain the fuel tank.

CAUTION: The propane fuel tank contains liquid and vaporous propane at pressures up to 312 psi. Failure to drain the tank before service may cause fire and/or personal injury.

1. Contact a local propane distributor to drain the propane fuel tank.
2. After draining, a small amount of propane vapor will remain in the tank. Vent the vapor in a safe approved manner following all guidelines and regulations. Refer to NFPA 58 for more information.

FUEL TANK LOCK-OFF REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer *to Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the fuel tank cover bolts and the cover.

CAUTION: The propane fuel tank contains liquid and vaporous propane at pressures up to 312 psi. Failure to drain the tank before service may cause fire and/or personal injury.

4. Drain the propane fuel tank. Refer to *Propane Fuel Tank Draining.*
5. Disconnect the fuel tank lock-off electrical connector.
6. Disconnect the fuel line from the fuel tank lock-off.
7. Remove the fuel tank lock-off from the tank.

Installation Procedure

Important!
- Do not use Teflon® tape on any fuel fitting. Use liquid pipe thread sealant.

1. Apply liquid pipe thread sealant to the fuel tank lock-off fitting.
2. Install the lock-off in the tank.
   - Tighten to 2-3 TFFT.
3. Connect the fuel line to the fuel tank lock-off.
   - Tighten to 37 N•m (27 lb-ft).
4. Connect the fuel tank lock-off electrical connector.
5. Connect the negative battery cable.
6. Fill the propane fuel tank.
7. Start the vehicle and leak check the propane fuel system at each serviced fitting.
8. Install the fuel tank cover and bolts.

FUEL SENDING UNIT REPLACEMENT

Removal Procedure

1. Remove the propane fuel tank. Refer to *Propane Fuel Tank Replacement.*

CAUTION: The propane fuel tank contains liquid and vaporous propane at pressures up to 312 psi. Failure to drain the tank before service may cause fire and/or personal injury.

2. Drain the propane fuel tank. Refer to *Propane Fuel Tank Draining.*
3. Remove the fuel sending unit from the tank.

Installation Procedure

Important!
- Do not use Teflon® tape on any fuel fitting. Use liquid pipe thread sealant.

1. Apply liquid pipe thread sealant to the fittings of the fuel sending unit.
2. Install the fuel sending unit in the tank.
   - Tighten to 1-3 TFFT.
3. Install the propane fuel tank. Refer to *Propane Fuel Tank Replacement.*

PRESSURE RELIEF DEVICE (PRD) (TANK) REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer *to Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the fuel tank cover bolts and the cover.

CAUTION: The propane fuel tank contains liquid and vaporous propane at pressures up to 312 psi. Failure to drain the tank before service may cause fire and/or personal injury.

4. Drain the propane fuel tank. Refer to *Propane Fuel Tank Draining.*
5. Disconnect the following electrical connectors:
   - Fuel sending unit (FSU).
   - Fuel tank lock-off.
6. Remove the PRD from the tank.

Installation Procedure

Important!
- Do not use Teflon® tape on any fuel fitting. Use liquid pipe thread sealant.

1. Apply liquid pipe thread sealant to the PRD threads.
2. Install the PRD to the tank.
   - Tighten the PRD to 2-3 TFFT.
3. Connect the following electrical connectors:
   - Fuel tank lock-off.
   - Fuel sending unit (FSU).
4. Fill the propane fuel tank.
5. Leak check the propane fuel system at the PRD.
6. Install the fuel tank cover the mounting bolts.
   - Tighten the bolts to 22 N•m (16 lb-ft).
7. Connect the negative battery cable.

LIQUID LEVEL GAUGE (TANK) REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer *to Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the fuel tank cover bolts and the cover.

CAUTION: The propane fuel tank contains liquid and vaporous propane at pressures up to 312 psi. Failure to drain the tank before service may cause fire and/or personal injury.

4. Drain the propane fuel tank. Refer to *Propane Fuel Tank Draining.*
5. Disconnect the following electrical connectors:
   - Fuel sending unit.
   - Fuel tank lock-off.
6. Disconnect the fuel line from the liquid level gauge.
7. Remove the liquid level gauge from the tank.

Installation Procedure

Important!
- Do not use Teflon® tape on any fuel fitting. Use liquid pipe thread sealant.

1. Apply liquid pipe thread sealant to the liquid level gauge threads.
2. Install the liquid level gauge to the tank.
   - Tighten the liquid level gauge to 2-3 TFFT.
3. Connect the line to the liquid level gauge
4. Connect the following electrical connectors:
   - Fuel tank lock-off.
   - Fuel sending unit.
5. Fill the propane fuel tank.
6. Leak check the propane fuel system at the liquid level gauge.
7. Install the fuel tank cover and mounting bolts.
   - Tighten the bolts to 16 N•m (12 lb-ft).
8. Connect the negative battery cable.

LIQUID LEVEL GAUGE (FILL VALVE) REPLACEMENT

Removal Procedure

1. **Disconnect the negative battery cable.**
2. **Shut the liquid level gauge at the fuel tank off by turning clockwise.**
3. Relieve the fuel pressure in the liquid level gauge line. Refer *to Propane Fuel System Pressure Relief.*
4. Remove the liquid level gauge from the fill valve bracket.

Installation Procedure

Important!
- Do not use Teflon® tape on any fuel fitting. Use liquid pipe thread sealant.

1. **Apply liquid pipe thread sealant to the liquid level gauge threads.**
2. **Install the liquid level gauge to the fill valve bracket.**
   - Tighten the liquid level gauge to 2-3 TFFT.
3. Open liquid level gauge at fuel tank by turning valve counter clockwise.
4. Leak check the propane fuel system at the liquid level gauge.
5. Connect the negative battery cable.

FUEL LINE REPLACEMENT

TANK TO FRAME UNION

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove any clips, clamps or brackets from the fuel line.
4. Disconnect the fuel line at the tank.
5. Disconnect the fuel line at the union. Discard the O-ring.
6. Remove the fuel line from the vehicle.

Installation Procedure

1. Install the fuel line in the vehicle.

2. Connect the fuel line at the union using a new O-ring. Lubricate the O-ring with petroleum jelly or the equivalent.
   - Tighten the fitting to 37 N•m (27 lb-ft).
3. Connect the fuel line at the tank.
   - Tighten the fitting to 37 N•m (27 lb-ft).
4. Install any clips, clamps to brackets to the fuel line.
5. Connect the negative battery cable.
6. Start the vehicle and leak check the propane fuel system at each serviced fitting.

FRAME UNION TO LPG FUEL FILTER

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove any clips, clamps or brackets from the fuel line.
4. Disconnect the fuel line at the filter.
5. Disconnect the fuel line at the union. Discard the O-ring.
6. Remove the fuel line from the vehicle.

Installation Procedure

1. Install the fuel line in the vehicle.
2. Connect the fuel line at the union using a new O-ring. Lubricate the O-ring with petroleum jelly or the equivalent.
   - Tighten the fitting to 37 N•m (27 lb-ft).
3. Connect the fuel line at the filter.
   - Tighten the fitting to 37 N•m (27 lb-ft).
4. Install any clips, clamps to brackets to the fuel line.
5. Connect the negative battery cable.
6. Start the vehicle and leak check the propane fuel system at each serviced fitting.

LPG FUEL FILTER TO UNDERHOOD LOCK-OFF

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the IP lower trim panel from the IP.
4. Remove the center consol mounting hardware.
5. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
6. Remove the center consol.
7. Release the engine cover retaining straps and remove the cover.
8. Remove any clips, clamps or brackets from the fuel line.
9. Disconnect the fuel line at the underhood LPL.
10. Disconnect the fuel line at the filter.
11. Remove the fuel line from the vehicle.

Installation Procedure

1. Install the fuel line in the vehicle.
2. Connect the fuel line at the filter.
   - Tighten the fitting to 37 N•m (27 lb-ft).
3. Connect the fuel line at the underhood LPL.
   - Tighten the fitting to 37 N•m (27 lb-ft).
4. Install any clips, clamps to brackets to the fuel line.
5. Connect the negative battery cable.
6. Start the vehicle and leak check the propane fuel system at each serviced fitting.
7. Install the engine cover and connect the retaining straps.
8. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
9. Install the center consol.
10. Install the center consol mounting hardware.
11. Install the IP lower trim panel to the IP.

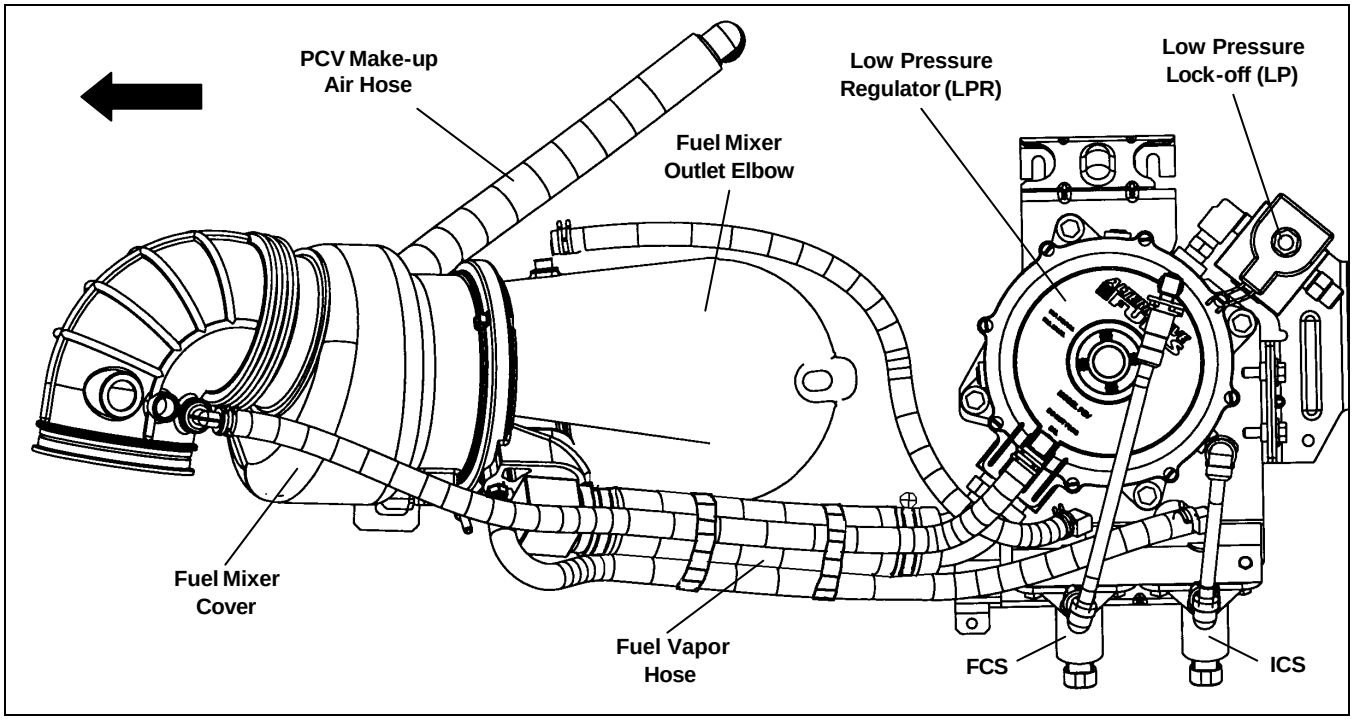
PROPANE FUEL FILTER REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Disconnect the fuel inlet line from the filter.
4. Disconnect the fuel outlet line from the filter.
5. Remove the nut retaining the filter clamp.
6. Remove the propane fuel filter.

Installation Procedure

1. Install the propane fuel filter
2. Install and secure the filter clamp and nut.
3. Connect the fuel outlet line to the filter.
   - Tighten the fitting to 37 N•m (27 lb-ft).
4. Connect the fuel inlet line to the filter.
   - Tighten the fitting to 37 N•m (27 lb-ft).
5. Start the vehicle and leak check the propane fuel system at each serviced fitting.



LOW PRESSURE LOCK-OFF (LPL) REPLACEMENT (UNDERHOOD)

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the IP lower trim panel from the IP.
4. Remove the center consol mounting hardware.
5. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
6. Remove the center consol.
7. Release the engine cover retaining straps and remove the cover.
8. Disconnect the fuel line from the LPL.
9. Remove the LPL to bracket mounting bolts.
10. Disconnect the LPL electrical connector.
11. Disconnect the ICS fuel line from the LPR.
12. Disconnect the FCS vacuum line from the LPR.
13. Remove the LPR to bracket mounting bolts.
14. Remove the fuel vapor hose clamp at the elbow.
15. Remove the LPR from the bracket with the coolant hoses attached.
16. Remove the LPL from the LPR.

Installation Procedure

Important!

- Do not use Teflon tape on any fuel fitting. Use a liquid pipe thread sealant when installing fittings.

1. Apply pipe thread sealant to the LPR inlet fitting.
2. Install the LPL to the LPR. Tighten the LPL finger tight plus 1 to 3 turns and place the LPL in the correct orientation.
3. Position the LPR on the mounting bracket while connecting the fuel vapor hose.
4. Install the fuel vapor hose clamp.
   - Tighten the clamp to 2 N•m (18 lb-in).
5. Install the LPR to bracket mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
6. Connect the FCS vacuum line to the LPR.
7. Connect the ICS vacuum line to the LPR.
8. Connect the LPL electrical connector.
9. Install the LPL to bracket mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
10. Connect the fuel line to the LPL.
    - Tighten the fitting to 37 N•m (27 lb-ft).
11. Connect the negative battery cable.
12. Start the vehicle and leak check the propane fuel system at each serviced fitting.
13. Install the engine cover and connect the retaining straps.
14. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
15. Install the center consol.
16. Install the center consol mounting hardware.
17. Install the IP lower trim panel to the IP.

LOW PRESSURE REGULATOR (LPR) REPLACEMENT

Removal Procedure

1. Relieve the propane fuel system pressure. Refer to *Propane Fuel System Pressure Relief.*
2. Disconnect the negative battery cable.
3. Remove the IP lower trim panel from the IP.
4. Remove the center console mounting hardware.
5. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
6. Remove the center consol.
7. Release the engine cover retaining straps and remove the cover.
8. Disconnect the fuel line from the LPL.
9. Remove the LPL to bracket mounting bolts.
10. Disconnect the LPL electrical connector.
11. Disconnect the ICS fuel line from the LPR.
12. Disconnect the FCS vacuum line from the LPR.
13. Remove the LPR to bracket mounting bolts.
14. Remove the fuel vapor hose clamp at the elbow.
15. Clamp the coolant hoses to the LPR or drain the radiator.
16. Disconnect the coolant hoses from the LPR.
17. Remove LPR from the bracket.

Disassembly Procedure

1. Loosen the hose clamp and remove the fuel vapor hose from the LPR outlet fitting.
2. Remove the LPL from the LPR.

Assembly Procedure

Important!

- Do not use Teflon tape on any fuel fitting. Use a liquid pipe thread sealant when installing fittings.

1. Apply Teflon pipe thread sealant to the threads of the LPR inlet fitting.
2. Install the LPL to the LPR outlet fitting.
   - Tighten the LPL finger tight plus 1 to 2 turns and place the LPL in the correct orientation.
3. Install the fuel vapor hose and clamp to the LPR outlet fitting.
   - Tighten the clamp to 2 N•m (18 lb-in).

Installation Procedure

1. Position the LPR on the mounting bracket while connecting the fuel vapor hose.
2. Install the fuel vapor hose clamp.
   - Tighten the clamp to 2 N•m (18 lb-in).
3. Connect the coolant hoses to the LPR.
4. Install the LPR to bracket mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
5. Connect the FCS vacuum line to the LPR.
6. Connect the ICS vacuum line to the LPR.
7. Connect the LPL electrical connector.
8. Install the LPL to bracket mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
9. Connect the fuel line to the LPL.
   - Tighten the fitting to 37 N•m (27 lb-ft).
10. Connect the negative battery cable.
11. Start the vehicle and leak check the propane fuel system at each serviced fitting.
12. Install the engine cover and connect the retaining straps.
13. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
14. Install the center consol.
15. Install the center consol mounting hardware.
16. Install the IP lower trim panel to the IP.
17. Using the Schrader valve on the LPR, bleed the cooling system.
18. Start the vehicle and leak check the propane fuel system at each serviced fitting.

FUEL CONTROL SOLENOID (FCS) REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the IP lower trim panel from the IP.
3. Remove the center consol mounting hardware.
4. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
5. Remove the center consol.
6. Release the engine cover retaining straps and remove the cover.
7. Disconnect the FCS vacuum line from the solenoid.
8. Disconnect the FCS electrical connector.
9. Remove the two (2) FCS mounting bolts and the FCS.

Installation Procedure

1. Install the FCS and two (2) mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
2. Connect the FCS electrical connector.
3. Connect the FCS vacuum line to the solenoid.
4. Install the engine cover and connect the retaining straps.
5. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
6. Install the center consol.
7. Install the center consol mounting hardware.
8. Install the IP lower trim panel to the IP.
9. Connect the negative battery cable.

IDLE CONTROL SOLENOID (ICS) REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the IP lower trim panel from the IP.
3. Remove the center consol mounting hardware.
4. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
5. Remove the center console.
6. Release the engine cover retaining straps and remove the cover.
7. Disconnect the ICS fuel supply line from the solenoid.
8. Disconnect the ICS electrical connector.
9. Remove the two (2) ICS mounting bolts and the ICS.

Installation Procedure

1. Install the ICS and the two mounting bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
2. Connect the ICS electrical connector.
3. Connect the ICS fuel supply line to the solenoid.
4. Install the engine cover and connect the retaining straps.
5. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
6. Install the center consol.
7. Install the center consol mounting hardware.
8. Install the IP lower trim panel to the IP.
9. Connect the negative battery cable.

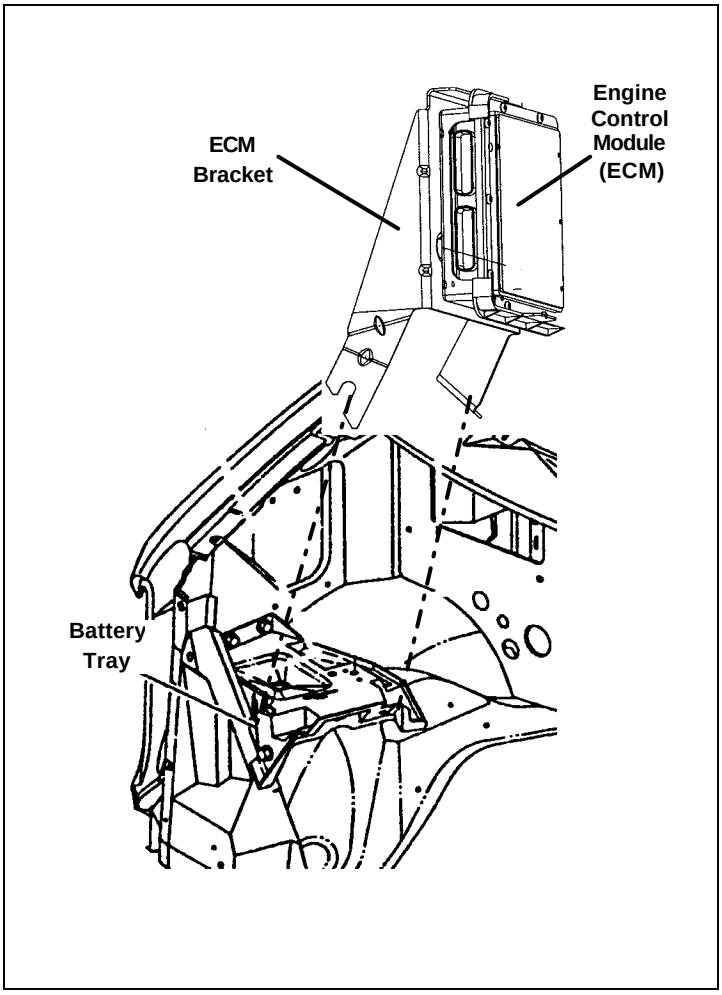
FUEL MIXER / OUTLET ELBOW / COVER ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the MAF and IAT sensor electrical connectors.
3. Remove the air cleaner housing with MAF sensor.
4. Remove the inlet bellows and from the elbow cover.
5. Remove the IP lower trim panel from the IP.
6. Remove the center consol mounting hardware.
7. Disconnect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
8. Remove the center consol.
9. Release the engine cover retaining straps and remove the cover.
10. Remove the one (1) elbow to throttle boy nut.
11. Remove the two (2) upper elbow support bracket bolts.
12. Loosen the one (1) lower elbow support bracket bolt.
13. Disconnect the PCV hose from the elbow.
14. Disconnect the two (2) vacuum hoses from the elbow.
15. Remove the fuel vapor hose clamp.
16. Remove the fuel mixer / outlet elbow / cover assembly from the throttle body.

Installation Procedure

1. Install the fuel mixer / outlet elbow / cover assembly to the throttle body while connecting the fuel vapor hose.
2. Install the fuel vapor hose clamp.
   - Tighten the clamp to 2 N•m (18 lb-in).
3. Connect the two (2) vacuum hoses to the elbow.
4. Connect the PCV make-up air hose to the elbow cover.
5. Install the one (1) elbow to throttle body nut.
   - Tighten the nut to 4 N•m (36 lb-in).
6. Tighten the one (1) lower elbow support bracket bolt.
   - Tighten the bolt to 28 N•m (21 lb-ft).
7. Install the two (2) upper elbow support bracket bolts.
   - Tighten the bolts to 12 N•m (9 lb-ft).
8. Install the engine cover and connect the retaining straps.
9. Connect the electrical connectors for the lighter, accessory plug and storage compartment lamp.
10. Install the center consol.
11. Install the center consol mounting hardware.
12. Install the IP lower trim panel to the IP.
13. Install the air cleaner housing.
14. Connect the MAF and IAT sensor electrical connectors.
15. Connect the negative battery cable.



ALTERNATIVE FUEL ENGINE CONTROL MODULE (AF ECM) REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the coolant surge tank.
3. Un-snap the AF ECM from the bracket.
4. Disconnect the two (2) AF ECM electrical connectors.

Installation Procedure

1. Connect the two (2) AF ECM electrical connectors.
2. Snap the AF ECM in the bracket.
3. Install the coolant surge tank.
4. Connect the negative battery cable.

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PROPANE FUEL SYSTEM INSPECTION

Inspect the propane fuel system hoses and vacuum lines for cracks, wear or other damage. Replace if necessary. Inspect the propane fuel system brackets for cracks, deformation or other damage. Replace if necessary. Inspect all fasteners and service as necessary